HW7

Contents

- Q1 input
- a)
- b)
- c)
- Create MCNF inputs
- solve
- report
- d)
- input
- Create MCNF inputs
- solve
- Report
- Q2 input
- Create data
- Dijkstra's algorithm
- Q3 input
- Get road network
- Label type of road
- Plot roads
- Add connector roads from cities to road network
- Convert road distances to travel times (needs to be after ADDCONNECTOR)
- Find shortest path
- Distance of shortest time route
- Q4 input
- Create MILP model
- Solve using Gurobi
- Report results
- Q5 input
- Create MILP model
- Solve using Gurobi
- Report results

Q1 input

```
clear
disp('Question 1')
s = [20548 26149 36317];
dem = [40 55 35 70 25];
c = [30669 38339 30732 23830 23154];
Sup = uszip5(mand(s, uszip5('Code5')));
Cust = uszip5(mand(c, uszip5('Code5')));
```

```
Question 1
```

a)

```
disp('a)')
D = dists(Sup.XY, Cust.XY, 'mi');
% mdisp(D)
% argmin(D, 1)
F = full(sparse(argmin(D,1),1:length(dem),dem))
TCa = D.*F;
TCa = sum(sum(D.*F));
for i=1:length(s)
    if any(F(i,:))
        fprintf(['DC%d should supply %s products to customers in %s, '...
        'respectively\n'], i, int2str(nonzeros(F(i,:))'),...
        int2str(c(find(any(F(i,:),1)))));
    end
end
fprintf('Total ton-miles is %.2f.\n', TCa)
```

```
a)

F =

     0     0     0    70    25
     0     0     0     0     0
    40    55    35     0     0

DC1 should supply 70  25 products to customers in 23830  23154, respectively
DC3 should supply 40  55  35 products to customers in 30669  38339  30732, respectively
Total ton-miles is 43046.22.
```

b)

```
disp('b)')
sup = [60 90 80]';
% mdisp([D sup; dem 0])
[F,TCb] = trans(D,sup,dem);
TCb
fprintf('The change in total ton-miles is %.2f.\n', TCb-TCa);
```

```
b)

TCb =

   5.7539e+04

The change in total ton-miles is 14493.13.
```

c)

```
disp('c)')
```

```
c)
```

Create MCNF inputs

```
IJC = lev2list(D);
IJCU = [IJC repmat(30, length(IJC),1)];
s = [sup' -dem];
```

solve

```
lp = mcnf2lp(IJCU,s);
[x,TCc,XFlg,out] = lplog(lp{:});
[f,TCc,nf] = lp2mcnf(x,IJC,s);
```

report

```
IJF = [IJC(:,[1 2]) f];
AF = list2adj(IJF);
F = adj2lev(AF,size(D))
TCc
fprintf('The change in total ton-miles is %.2f.\n', TCc-TCb);
```

```
F =

     0     0     0    30    25
    10    25    25    30     0
    30    30    10    10     0


TCc =

   6.4074e+04

The change in total ton-miles is 6534.29.
```

d)

```
disp('d)')
```

```
d)
```

input

```
p = [28124 27325 37421 27513];
Plts = uszip5(mand(p, uszip5('Code5')));
```

Create MCNF inputs

```
C23 = D;
C12 = dists(Plts.XY, Sup.XY, 'mi');
W = lev2adj(C12,C23);
IJC = adj2list(W);
s = [repmat(60, 4,1)'  zeros(3,1)' -dem];
```

solve

```
lp2 = mcnf2lp(IJC,s);
[x,TCd] = lplog(lp2{:});
[f,TC,nf] = lp2mcnf(x,IJC,s);
```

Report

```
IJF = [IJC(:,[1 2]) f];
AF = list2adj(IJF);
[F12,F23] = adj2lev(AF,[4 3 5])

for i=1:4
    fprintf(['Plant%d should supply %s products to DCs in %s, '...
    'respectively\n'], i, int2str(nonzeros(F12(i,:))'),...
    int2str(p(find(any(F12(i,:),1)))));
end
for i=1:3
    if any(F23(i,:))
        fprintf(['DC%d should supply %s products to customers in %s, '...
        'respectively\n'], i, int2str(nonzeros(F23(i,:))'),...
        int2str(c(find(any(F23(i,:),1)))));
    end
end
```

```
F12 =

     0     0    60
    35     0    10
     0     0    60
    60     0     0


F23 =

     0     0     0    70    25
     0     0     0     0     0
    40    55    35     0     0

Plant1 should supply 60 products to DCs in 37421, respectively
Plant2 should supply 35  10 products to DCs in 28124  37421, respectively
Plant3 should supply 60 products to DCs in 37421, respectively
Plant4 should supply 60 products to DCs in 28124, respectively
DC1 should supply 70  25 products to customers in 23830  23154, respectively
DC3 should supply 40  55  35 products to customers in 30669  38339  30732, respectively
```

Q2 input

```
clear
disp('Question 2b)')
```

```
Question 2b)
```

Create data

```
IJD = [
    1 -2 14
    1 -6 17
    1 -8 13
    1 -9 1
    1 -10 16
    2 -3 2
    2 -4 6
    2 -7 16
    2 -9 10
    2 -10 7
    3 -4 5
    3 -8 8
    3 -9 9
    4 -5 14
    4 -7 14
    5 -6 7
    5 -7 1
    5 -10 16
    6 -8 19
    6 -10 10
    7 -10 1
    8 -9 10];
```

Dijkstra's algorithm

```
[d,p] = dijkdemo(list2adj(IJD),3,6)
```

```
Node:    1    2    3    4    5    6    7    8    9   10

   S:    0    0    1*   0    0    0    0    0    0    0
   d:  Inf  Inf    0  Inf  Inf  Inf  Inf  Inf  Inf  Inf
pred:    0    0    0    0    0    0    0    0    0    0

   S:    0    1*   1    0    0    0    0    0    0    0
   d:  Inf    2    0    5  Inf  Inf  Inf    8    9  Inf
pred:    0    3    0    3    0    0    0    3    3    0

   S:    0    1    1    1*   0    0    0    0    0    0
   d:   16    2    0    5  Inf  Inf   18    8    9    9
pred:    2    3    0    3    0    0    2    3    3    2

   S:    0    1    1    1    0    0    0    1*   0    0
   d:   16    2    0    5   19  Inf   18    8    9    9
pred:    2    3    0    3    4    0    2    3    3    2

   S:    0    1    1    1    0    0    0    1    1*   0
   d:   16    2    0    5   19   27   18    8    9    9
pred:    2    3    0    3    4    8    2    3    3    2

   S:    0    1    1    1    0    0    0    1    1    1*
   d:   10    2    0    5   19   27   18    8    9    9
pred:    9    3    0    3    4    8    2    3    3    2

   S:    1*   1    1    1    0    0    0    1    1    1
   d:   10    2    0    5   19   19   10    8    9    9
pred:    9    3    0    3    4   10   10    3    3    2

   S:    1    1    1    1    0    0    1*   1    1    1
   d:   10    2    0    5   19   19   10    8    9    9
pred:    9    3    0    3    4   10   10    3    3    2

   S:    1    1    1    1    1*   0    1    1    1    1
   d:   10    2    0    5   11   19   10    8    9    9
pred:    9    3    0    3    7   10   10    3    3    2

   S:    1    1    1    1    1    1*   1    1    1    1
   d:   10    2    0    5   11   18   10    8    9    9
pred:    9    3    0    3    7    5   10    3    3    2


d =

    18


p =
     3     2    10     7     5     6
```

Q3 input

```
clear
disp('Question 3')
Ral = [-78.701389 35.7725];
Atl = [-84.39 33.771944];
XY1 = [Ral; Atl];
```

```
Question 3
```

Get road network

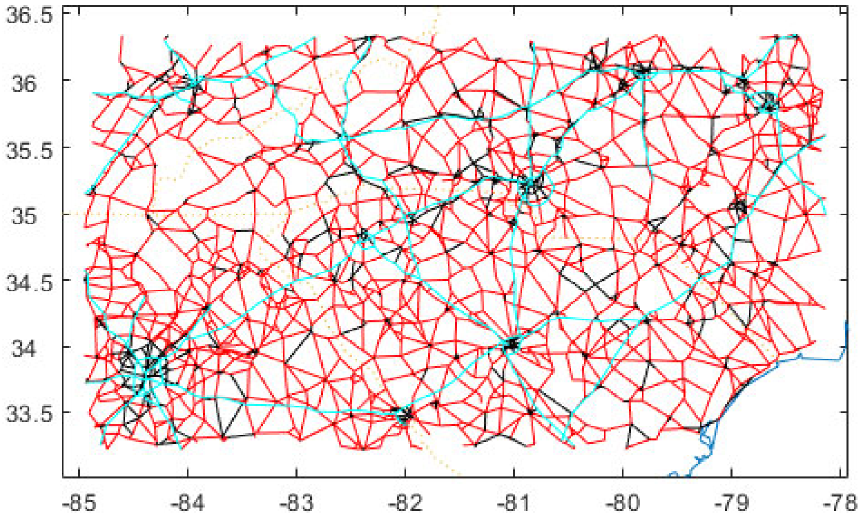
```
expansionAroundXY = 0.1;
[XY2,IJD,isXY,isIJD] = subgraph(usrdnode('XY'),...
   isinrect(usrdnode('XY'),boundrect(XY1,expansionAroundXY)),...
   usrdlink('IJD'));
```

Label type of road

```
s = usrdlink(isIJD);
isI = s.Type == 'I';         % Interstate highways
isIR = isI & s.Urban == ' '; % Rural Interstate highways
isIU = isI & ~isIR;          % Urban Interstate highways
isR = s.Urban == ' ' & ~isI; % Rural non-Interstate roads
isU = ~isI & ~isR;           % Urban non-Interstate roads
```

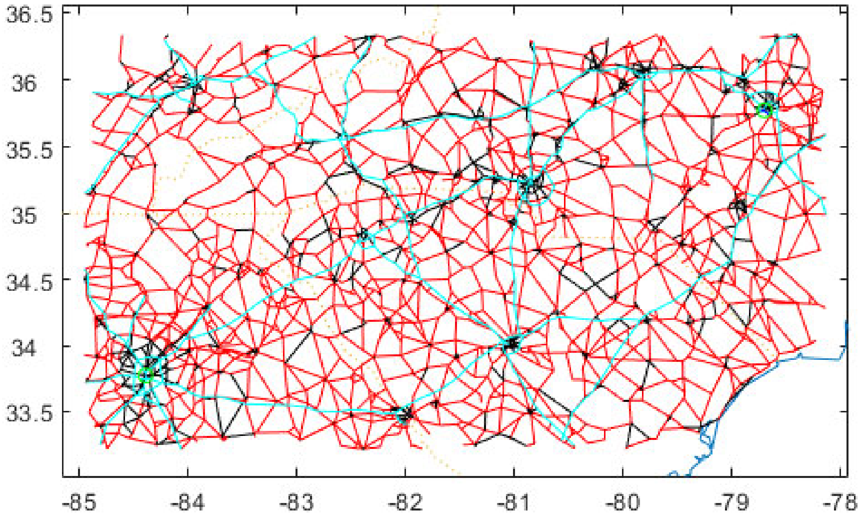
Plot roads

```
makemap(XY2,0.03)  % 3% expansion
h = [];  % Keep handle to each plot for legend
h = [h pplot(IJD(isR,:),XY2,'r-','DisplayName','Rural Roads')];
h = [h pplot(IJD(isU,:),XY2,'k-','DisplayName','Urban Roads')];
h = [h pplot(IJD(isI,:),XY2,'c-','DisplayName','Interstate Roads')];
```



Add connector roads from cities to road network

```
[IJD11,IJD12,IJD22] = addconnector(XY1,XY2,IJD);
h = [h pplot(IJD12,[XY1; XY2],'b-','DisplayName','Connector Roads')];
h = [h pplot(XY1,'go','DisplayName','Destinations')];
```



Convert road distances to travel times (needs to be after ADDCONNECTOR)

```
v.IR = 75;  % Rural Interstate highways average speed (mph)
v.IU = 65;  % Urban Interstate highways average speed (mph)
```

```
v.R = 50;   % Rural non-Interstate roads average speed (mph)
v.U = 25;   % Urban non-Interstate roads average speed (mph)
v.C = 20;   % Facility to road connector average speed (mph)

IJT = IJD;
IJT(isIR,3) = IJD(isIR,3)/v.IR;
IJT(isIU,3) = IJD(isIU,3)/v.IU;
IJT(isR,3) = IJD(isR,3)/v.R;
IJT(isU,3) = IJD(isU,3)/v.U;

IJT22 = IJD22;                % road to road
IJT22(:,3) = IJT(:,3);
IJT12 = IJD12;                % facility to road
IJT12(:,3) = IJD12(:,3)/v.C;  % (IJD11 facility to facility arcs ignored)
```

Find shortest path

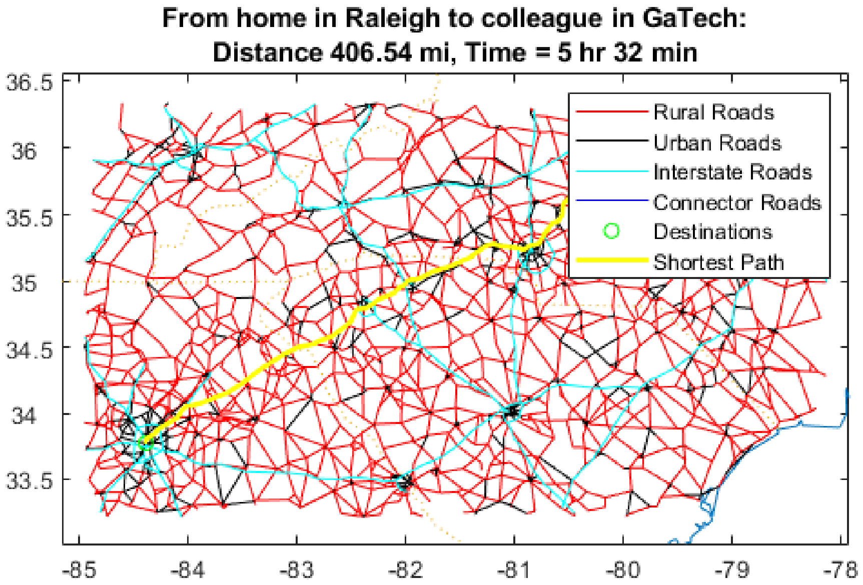
```
[~,P] = dijk(list2adj([IJT12; IJT22]),1:2);
[T, p] = dijk(list2adj([IJT12; IJT22]),1,2);
```

Distance of shortest time route

```
W = list2adj([IJD12; IJD22]);
D = locTC(pred2path(P,1,2),W);

h = [h ...
   pplot({p},[XY1;XY2],'y-','LineWidth',2,'DisplayName','Shortest Path')];
title(sprintf(['From home in Raleigh to colleague in GaTech:\n'...
    'Distance %.2f mi, Time = %d hr %d min'],D,floor(T),round(60*(T-floor(T)))));
legend(h),shg
fprintf(['From home in Raleigh to colleague in GaTech: Distance %.2f mi,'...
    'Time = %d hr %d min.\n'],D,floor(T),round(60*(T-floor(T))));
```

```
From home in Raleigh to colleague in GaTech: Distance 406.54 mi,Time = 5 hr 32 min.
```


From home in Raleigh to colleague in GaTech:
Distance 406.54 mi, Time = 5 hr 32 min

Q4 input

```
clear
disp('Question 4')
T = 26;
rng(1964);
D = round([gamrnd(6,4,T,1) gamrnd(4,3,T,1)]);

K = [60 50;
     55 45;
     50 35];

Cp = [12  20;
      75 130;
      35  60];
h = 0.4/365.25*7;
Ci = cumsum(Cp,1)*h      % inventory cost of product g for stage m ($/ton)

Cs = [400 600;         % stage-m product-g setup cost ($)
       90  110;
       50  60];
yinit = [0  0;           % initial product g inventory at stage m (ton)
         0  0;
         0 sum(D(1:2,2))];
yfinal = zeros(3,2);     % final product g inventory at stage m (ton)
k0 = [1 0;               % initial setup at stage m for product g
      1 0;
      1 0];
M = size(K,1);           % number of production stages = 3
T = size(D,1);           % number of periods of production = 6
G = size(K,2);           % number of products produced = 2
```

```
Question 4

Ci =

    0.0920    0.1533
    0.6669    1.1499
    0.9352    1.6099
```

Create MILP model

```
Cp = reshape(repmat(Cp,[T 1 1]),M,T,G);     % create M x T x G array (3-D)
Ci = reshape(repmat(Ci,[T+1 1 1]),M,T+1,G); % create M x (T+1) x G array
Ci(:,1,:) = 0;   % intital inventory cost already accounted for last period
Cs = reshape(repmat(Cs,[T 1 1]),M,T,G);     % create M x T x G array
mp = Milp('PPlan');
mp.addobj('min',Cp,Ci,Cs,zeros(M,T,G));     % zeros(M,T,G) dummy array for k
for g = 1:G
   for t = 1:T
      for m = 1:M-1
         mp.addcstr({[1 -1],{[m m+1],t,g}},{[1 -1],{m,[t t+1],g}},0,0,'=',0)
      end
      mp.addcstr({M,t,g},{[1 -1],{M,[t t+1],g}},0,0,'=',D(t,g))
      for m = 1:M
         mp.addcstr({m,t,g},0,0,'<=',{K(m,g),{m,t,g}})
      end
   end
   for m = 1:M
      mp.addcstr(0,0,{-1,{m,1,g}},{m,1,g},'<=',k0(m,g))
      for t = 2:T
         mp.addcstr(0,0,{-1,{m,t,g}},{[1 -1],{m,[t t-1],g}},'<=',0)
      end
   end
end
for m = 1:M, for t = 1:T, mp.addcstr(0,0,0,{m,t,':'},'=',1), end, end
mp.addlb(0,horzcat(reshape(yinit,M,1,G),zeros(M,T-1,G),reshape(yfinal,M,1,G)),0,0);
mp.addub(Inf,horzcat(reshape(yinit,M,1,G),inf(M,T-1,G),reshape(yfinal,M,1,G)),1,1);
mp.addctype('C','C','B','B');
```

Solve using Gurobi

```
clear params
model = mp.milp2gb;
params.outputflag = 1;
result = gurobi(model, params);
x = mp.namesolution(result.x);
TC = result.objval
```

```
Academic license - for non-commercial use only
Gurobi Optimizer version 9.0.3 build v9.0.3rc0 (win64)
Optimize a model with 546 rows, 630 columns and 1502 nonzeros
Model fingerprint: 0x00bc7797
Variable types: 318 continuous, 312 integer (312 binary)
Coefficient statistics:
  Matrix range     [1e+00, 6e+01]
  Objective range  [1e-08, 6e+02]
  Bounds range     [1e+00, 1e+01]
  RHS range        [1e+00, 5e+01]
Presolve removed 121 rows and 135 columns
Presolve time: 0.01s
Presolved: 425 rows, 495 columns, 1232 nonzeros
Variable types: 286 continuous, 209 integer (209 binary)

Root relaxation: objective 1.436099e+05, 489 iterations, 0.01 seconds

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

```
     0     0 143609.941    0   78          - 143609.941      -     -    0s
     0     0 144268.858    0   80          - 144268.858      -     -    0s
     0     0 144272.967    0   80          - 144272.967      -     -    0s
     0     0 144272.967    0   81          - 144272.967      -     -    0s
     0     0 144518.079    0   77          - 144518.079      -     -    0s
     0     0 144529.424    0   86          - 144529.424      -     -    0s
     0     0 144530.767    0   86          - 144530.767      -     -    0s
     0     0 144530.803    0   86          - 144530.803      -     -    0s
     0     0 144580.900    0   85          - 144580.900      -     -    0s
     0     0 144582.791    0   86          - 144582.791      -     -    0s
     0     0 144582.827    0   86          - 144582.827      -     -    0s
     0     0 144596.542    0   89          - 144596.542      -     -    0s
     0     0 144596.823    0   89          - 144596.823      -     -    0s
     0     0 144611.494    0   86          - 144611.494      -     -    0s
     0     0 144612.835    0   88          - 144612.835      -     -    0s
     0     0 144620.523    0   90          - 144620.523      -     -    0s
     0     0 144621.149    0   91          - 144621.149      -     -    0s
     0     0 144621.180    0   91          - 144621.180      -     -    0s
     0     0 144621.373    0   90          - 144621.373      -     -    0s
     0     0 144621.373    0   90          - 144621.373      -     -    0s
H    0     0                    151086.83915 144621.373  4.28%     -    0s
     0     2 144621.373    0   89 151086.839 144621.373  4.28%     -    0s
*  125   125              50    148909.56988 145026.758  2.61%  22.7    0s
*  434   363              49    148695.48529 145045.947  2.45%  22.1    1s
H  882   622                    148637.53046 145662.276  2.00%  30.9    3s
* 1039   650              61    148472.31239 145662.276  1.89%  29.5    4s
H 1145   588                    147385.66297 145736.900  1.12%  30.5    4s
  1382   549 infeasible   25      147385.663 145873.501  1.03%  32.8    5s
  4115  1137 147105.156   23   71 147385.663 146448.884  0.64%  37.0   10s
H 4675  1286                    147385.66295 146480.361  0.61%  36.9   10s
H 6724  1866                    147361.29364 146614.082  0.51%  36.5   12s
H 7723  2067                    147344.15250 146667.693  0.46%  36.4   14s
  8667  2240 147047.097   31   49 147344.152 146709.161  0.43%  35.9   15s
 13522  2608 infeasible   32      147344.152 146854.682  0.33%  35.2   20s
 18138  2520 147154.049   29   51 147344.152 146941.400  0.27%  35.4   25s
 22584  2162 147136.669   25   73 147344.152 147020.046  0.22%  35.0   30s
H28256  1182                    147335.69610 147133.190  0.14%  34.6   34s
 28598  1156     cutoff   28      147335.696 147148.368  0.13%  34.6   35s

Cutting planes:
  Gomory: 28
  Cover: 3
  Implied bound: 6
  Clique: 2
  MIR: 75
  StrongCG: 1
  Flow cover: 136
  Flow path: 1
  Inf proof: 31
  Zero half: 5

Explored 30712 nodes (1052661 simplex iterations) in 37.05 seconds
Thread count was 4 (of 4 available processors)

Solution count 9: 147336 147344 147361 ... 151087

Optimal solution found (tolerance 1.00e-04)
Best objective 1.473356960999e+05, best bound 1.473356960999e+05, gap 0.0000%

TC =

   1.4734e+05
```

Report results

```
Fp = x.Cp;
Fi = x.Ci;
for g = 1:G
   mdisp(D(:,g)',[],[],['D' num2str(g)])
   mdisp(Fp(:,:,g),[],[],['Fp' num2str(g)])
   mdisp(Fi(:,:,g),[],[],['Fi' num2str(g)])
end
```

```
D1:   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26
--:--------------------------------------------------------------------------------------------------------
 1:  27  15  22  45  28  11  24  42  45  20  18  18  47  27  15  18  27  23  29  12  24  26  33  25  27  16

Fp1:   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26
---:--------------------------------------------------------------------------------------------------------
  1:  54  60   0   0  50  50  60  60  60  60  60   0   0   0   0   0   0   0   0   0  50  50  50   0   0   0
  2:  27  37   0  50  50  50   0   0  50  50  50   0   0  50  50  50   0   0   0   0  50  50  50   0   0   0
  3:  27  37   0  50  50  50   0   0  50  50  50   0   0  50  50  50   0   0   0   0  50  50  50   0   0   0

Fi1:   1   2   3   4   5   6   7   8    9   10   11   12   13   14   15  16  17  18  19  20  21  22  23  24  25  26  27
---:-------------------------------------------------------------------------------------------------------------------
  1:   0  27  50  50   0   0   0  60  120  130  140  150  150  150  100  50   0   0   0   0   0   0   0   0   0   0   0
  2:   0   0   0   0   0   0   0   0    0    0    0    0    0    0    0   0   0   0   0   0   0   0   0   0   0   0   0
  3:   0   0  22   0   5  27  66  42    0    5   35   67   49    2   25  60  92  65  42  13   1  27  51  68  43  16   0

D2:   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26
--:--------------------------------------------------------------------------------------------------------
 1:   6   5   8   9   7   4  12  14  21   8   6  13  25   7   5  14  10   9  25   4  13  12  12  19  19  17

Fp2:   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26
---:--------------------------------------------------------------------------------------------------------
  1:   0   0  39  50   0   0   0   0   0   0   0  29  35   0   0   0  10  30  50  50   0   0   0   0   0   0
  2:   0   0  28   0   0   0  26  35   0   0   0  29  35   0   0   0  10   9  31  35   0   0   0  19  19  17
  3:   0   0  28   0   0   0  26  35   0   0   0  29  35   0   0   0  10   9  31  35   0   0   0  19  19  17

Fi2:   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27
---:------------------------------------------------------------------------------------------------------------
  1:   0   0   0  11  61  61  61  35   0   0   0   0   0   0   0   0   0   0  21  40  55  55  55  55  36  17   0
  2:   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
  3:  11   5   0  20  11   4   0  14  35  14   6   0  16  26  19  14   0   0   0   6  37  24  12   0   0   0   0
```

Q5 input

```
clear
disp('Question 5')
K = [20;30];    % capacity of stage m in period t (ton)
D = [25 15 10 50 25 15]';  % demand in period t (ton)
Cp = [200; 800];           % production cost in stage m ($/ton)
h = 0.08/3+0.11;
Ci = cumsum(Cp)*h;          % inventory cost for stage m ($/ton)
Ck = [3000; 9000];          % fixed cost for stage m ($/ton)
yinit = [5; 0];            % initial inventory of stage m (ton)
yfinal = [7; 4];            % final inventory of stage m (ton)
M = size(K,1);             % number of production stages = 2
T = size(D,1);             % number of periods of production = 6
```

```
Question 5
```

Create MILP model

```
Cp = reshape(repmat(Cp,[T 1 1]),M,T);     % create M x T array
Ck = reshape(repmat(Ck,[T 1 1]),M,T);     % create M x T array
Ci = reshape(repmat(Ci,[T+1 1 1]),M,T+1); % create M x (T+1) array
Ci(:,1,:) = 0;   % intital inventory cost already accounted
mp = Milp('PPlan');
mp.addobj('min',Cp,Ci,Ck);

for t = 1:T
   for m = 1:M-1
      mp.addcstr({[1 -1],{[m m+1],t}},{[1 -1],{m,[t t+1]}},0,'=',0)
   end
   mp.addcstr({M,t},{[1 -1],{M,[t t+1]}},0,'=',D(t))
   mp.addcstr({':',t},0,'<=',{K',{':',t}})
   for m = 1:M
      mp.addcstr(0,{m,t},0,'<=',30)
   end
end

mp.addlb(0,[yinit zeros(M,T-1) yfinal], 0)
mp.addub(Inf,[yinit repmat(Inf,M,T-1) yfinal], 1)
mp.addctype('I','C','B')
```

Solve using Gurobi

```
clear params
model = mp.milp2gb;
params.outputflag = 1;
result = gurobi(model, params);
x = mp.namesolution(result.x);
TC = result.objval;
D = D';
```

```
Academic license - for non-commercial use only
Gurobi Optimizer version 9.0.3 build v9.0.3rc0 (win64)
Optimize a model with 30 rows, 38 columns and 78 nonzeros
Model fingerprint: 0x319d59f0
Variable types: 14 continuous, 24 integer (12 binary)
Coefficient statistics:
  Matrix range     [1e+00, 3e+01]
  Objective range  [1e-08, 9e+03]
  Bounds range     [1e+00, 7e+00]
  RHS range        [1e+01, 5e+01]
Found heuristic solution: objective 221238.00000
Presolve removed 18 rows and 14 columns
Presolve time: 0.00s
Presolved: 12 rows, 24 columns, 45 nonzeros
Variable types: 0 continuous, 24 integer (8 binary)

Root relaxation: objective 2.171447e+05, 15 iterations, 0.00 seconds

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

     0     0 217144.667    0    2 221238.000 217144.667  1.85%     -    0s
H    0     0                    220117.33333 217144.667  1.35%     -    0s
H    0     0                    219871.33333 217144.667  1.24%     -    0s
     0     0     cutoff    0      219871.333 219871.333  0.00%     -    0s

Explored 1 nodes (17 simplex iterations) in 0.01 seconds
Thread count was 4 (of 4 available processors)

Solution count 3: 219871 220117 221238
```

```
Optimal solution found (tolerance 1.00e-04)
Best objective 2.198713333334e+05, best bound 2.198713333334e+05, gap 0.0000%
```

Report results

```
Fp = x.Cp;
Fi = x.Ci;
Fk = x.Ck;
disp('Production plan is described below')
mdisp(D)
mdisp(Fp)
mdisp(Fi)
mdisp(Fk)
fprintf('The total cost with this plan is $%.2f.\n', TC)
```

```
Production plan is described below

D:   1   2   3   4   5   6
-:------------------------
1:  25  15  10  50  25  15

Fp:   1   2   3   4   5   6
--:------------------------
 1:  20  35  30  10  25  26
 2:  25  15  20  40  25  19

Fi:  1  2   3   4  5  6  7
--:-----------------------
 1:  5  0  20  30  0  0  7
 2:  0  0   0  10  0  0  4

Fk:  1  2  3  4  5  6
--:------------------
 1:  1  1  1  1  1  1
 2:  1  1  1  1  1  1
The total cost with this plan is $219871.33.
```

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