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Contents

QUESTION 1: Graphical method to solve

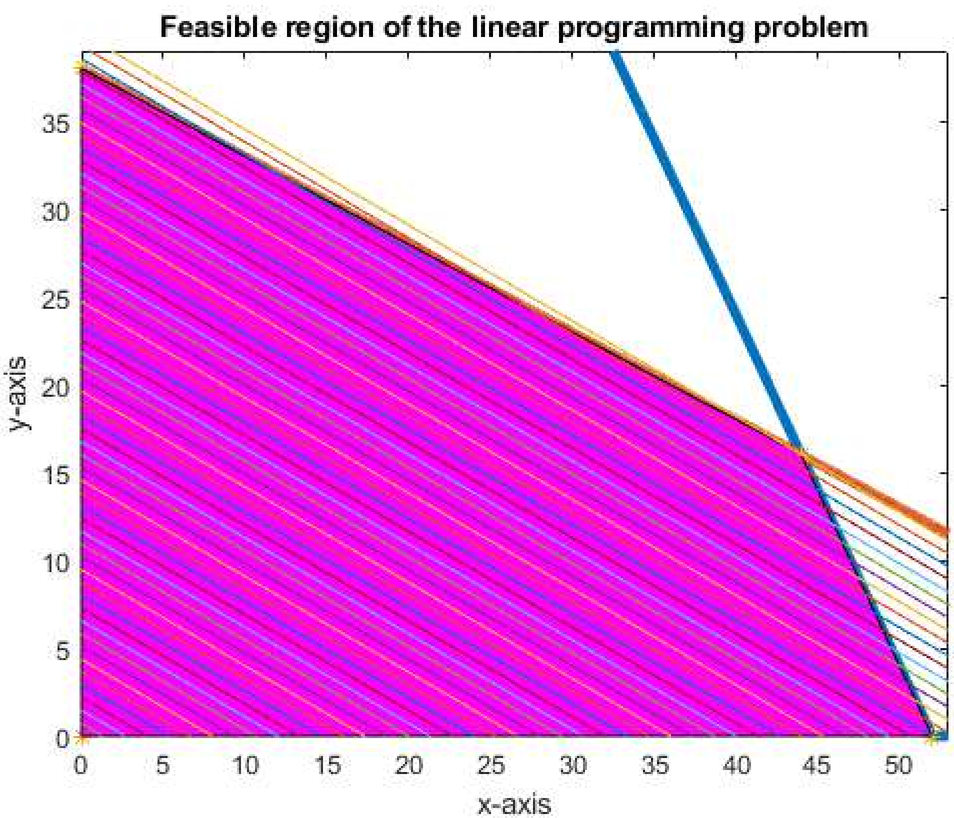
Max Z= 6x1+11x2 2x1+x2<=104 x1+2x2<=76 x2>=0 x1>=0

```
clf
clc
clear all
format short
%INPUT PARAMETERS
c=[6,11]; %cost objective function
A=[2,1;1,2;0,1;1,0];
B=[104;76;0;0];
% 1 for <=const and -1 for >= const
const=[1;1];%for lesser than function we have 1 and -1 for greater than
objective=1;%1 for maximization and -1 for minimization
n=size(A,1);
x1=0:0.01:max(B);

for i=1:n-2 %we take n-2 since we are also taking x1=0 and x2=0 as they have no significance in our graph
    y(i,:)=(B(i)-A(i,1)*x1)/A(i,2);
end

%DRAWING THE LINES
for i=1:n-2
    y(i,:)=max(0,y(i,:));
    plot(x1,y(i,:),'linewidth',4)
    hold on
end
hold on
%FINDING THE POINT OF INTERSECTION
pt=[0;0];
for i=1:size(A,1)
    A1=A(i,:);
    B1=B(i,:);
    for j=i+1:size(A,1)
        A2=A(j,:);
        B2=B(j,:);
        A3=[A1;A2];
        B3=[B1;B2];
        %X3=inv(A3)*B3
        X3=A3\B3;
        if(X3>=0)%since the number of chairs can never be negative
            pt= [pt X3];
        end
    end
```

```
end

X=pt';
X=unique(X,'rows')%solution
hold on

% KEEP ONLY FEASIBLE POINTS
x1=X(:,1);
x2=X(:,2);

for i=1:n-2 %n=size(A,1)-2
    %for greater than(1) equation we remove A*X'>B and for less than(-1) we do A(i,:)*X'<B(i)
    if(const(i)>0)
        ind=find(A(i,:)*X'>B(i));
        X(ind,:)=[];% indexes that are not satisfying the constraint are being replaced with empty set
    else
        ind=find(A(i,:)*X'<B(i));
        X(ind,:)=[];
    end
end

% EVALUATE THE OBJECTIVE FUNCTION VALUE
if(objective == 1)
    obj_val=c*X';
    [value, ind]=max(obj_val);
    fprintf("The max optimal value is : %f \n",value)
    fprintf("The max optimal point is : (%g,%g) \n",X(ind,:))
else
    obj_val=c*X';
    [value, ind]=min(obj_val);
    fprintf("The min optimal value is : %f \n",value)
    fprintf("The min optimal point is : (%g,%g) \n",X(ind,:))
end
X(ind,:);
Optimal=[X(ind,:) value];


% Shaded feasible region
x=X(:,1);
y=X(:,2);
scatter(X(:,1),X(:,2),'*')
hold on
k=convhull(x,y);%the shaded region where a and y is satisfied
fill(x(k),y(k),'m')

% setting the axes
xlim([0 max(x)+1])
ylim([0 max(y)+1])

xlabel('x-axis')
ylabel('y-axis')
title('Feasible region of the linear programming problem')
% legend('2x_1+x_2\leq104','x_1+2x_2\leq76','x_1,x_2\geq0')

%phase 7: Verification
x=0:0.1:max(B);
for z=0:8:value
    y=(z-c(1)*x)/c(2);
```

```
    plot(x,y)
    hold on
    drawnow
    pause(0.001)
end
hold on
```

```
X =

     0     0
     0    38
     0   104
    44    16
    52     0
    76     0

The max optimal value is : 440.000000
The max optimal point is : (44,16)
```



QUESTION 2: Graphical method to solve

Max Z= 5x1+8x2 2x1+x2<=200 x1+2x2<=150 x2<=60 x1,x2>=0

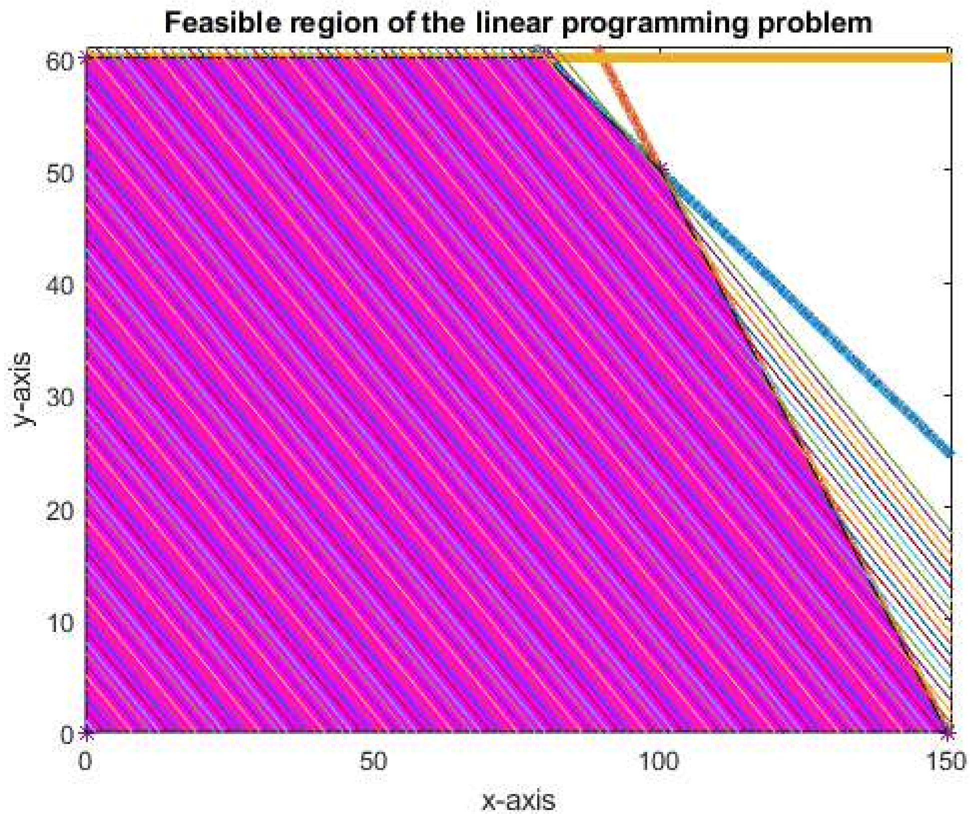
```
clf
clc
clear all
format short
%INPUT PARAMETERS
c=[5,8]; %cost objective function
```

```
A=[1,2;1,1;0,1;0,1;1,0];
B=[200;150;60;0;0];
% 1 for <=const and -1 for >= const
const=[1;1;1];%for lesser than function we have 1 and -1 for greater than
objective=1;%1 for maximization and -1 for minimization
n=size(A,1);
x1=0:0.01:max(B);

for i=1:n-2 %we take n-2 since we are also taking x1=0 and x2=0 as they have no significance in our graph
    y(i,:)=(B(i)-A(i,1)*x1)/A(i,2);
end

%DRAWING THE LINES
for i=1:n-2
    y(i,:)=max(0,y(i,:));
    plot(x1,y(i,:),'linewidth',4)
    hold on
end
hold on
%FINDING THE POINT OF INTERSECTION
pt=[0;0];
for i=1:size(A,1)
    A1=A(i,:);
    B1=B(i,:);
    for j=i+1:size(A,1)
        A2=A(j,:);
        B2=B(j,:);
        A3=[A1;A2];
        B3=[B1;B2];
        %X3=inv(A3)*B3
        X3=A3\B3;
        if(X3>=0)%since the number of chairs can never be negative
            pt= [pt X3];
        end
    end
end

X=pt';
X=unique(X,'rows')%solution
hold on

% KEEP ONLY FEASIBLE POINTS
x1=X(:,1);
x2=X(:,2);

for i=1:n-2 %n=size(A,1)-2
    %for greater than(1) equation we remove A*X'>B and for less than(-1) we do A(i,:)*X'<B(i)
    if(const(i)>0)
        ind=find(A(i,:)*X'>B(i));
        X(ind,:)=[];% indexes that are not satisfying the constraint are being replaced with empty set
    else
        ind=find(A(i,:)*X'<B(i));
        X(ind,:)=[];
    end
end

% EVALUATE THE OBJECTIVE FUNCTION VALUE
if(objective == 1)
```

```
    obj_val=c*X';
    [value, ind]=max(obj_val);
    fprintf("The max optimal value is : %f \n",value)
    fprintf("The max optimal point is : (%g,%g) \n",X(ind,:))
else
    obj_val=c*X';
    [value, ind]=min(obj_val);
    fprintf("The min optimal value is : %f \n",value)
    fprintf("The min optimal point is : (%g,%g) \n",X(ind,:))
end
X(ind,:);
Optimal=[X(ind,:) value];


% Shaded feasible region
x=X(:,1);
y=X(:,2);
scatter(X(:,1),X(:,2),'*')
hold on
k=convhull(x,y);%the shaded region where a and y is satisfied
fill(x(k),y(k),'m')

% setting the axes
xlim([0 max(x)+1])
ylim([0 max(y)+1])

xlabel('x-axis')
ylabel('y-axis')
title('Feasible region of the linear programming problem')
% legend('2x_1+x_2\leq104','x_1+2x_2\leq76','x_1,x_2\geq0')

%phase 7: Verification
x=0:0.1:max(B);
for z=0:8:value
    y=(z-c(1)*x)/c(2);
    plot(x,y)
    hold on
    drawnow
    pause(0.001)
end
hold on
```

```
Warning: Matrix is singular to working precision.

X =

     0     0
     0    60
     0   100
     0   150
    80    60
    90    60
   100    50
   150     0
   200     0
   Inf     0
```

```
The max optimal value is : 900.000000
The max optimal point is : (100,50)
```



QUESTION 3: Graphical method to solve

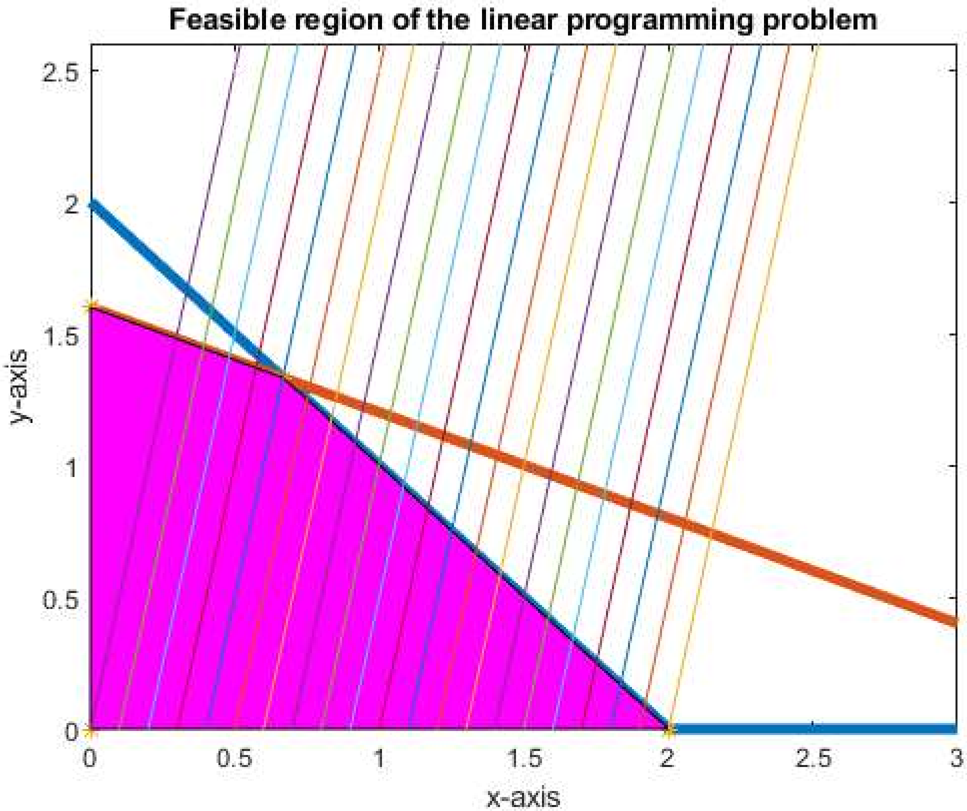
Max Z= 5x1-x2 x1+x2<=2 2x1+5x2<=8 x2>=0 x1>=0

```
clf
clc
clear all
format short
%INPUT PARAMETERS
c=[5,-1]; %cost objective function
A=[1,1;2,5;0,1;1,0];
B=[2;8;0;0];
% 1 for <=const and -1 for >= const
const=[1;1];%for lesser than function we have 1 and -1 for greater than
objective=1;%1 for maximization and -1 for minimization
n=size(A,1);
x1=0:0.01:max(B);

for i=1:n-2 %we take n-2 since we are also taking x1=0 and x2=0 as they have no significance in our graph
    y(i,:)=(B(i)-A(i,1)*x1)/A(i,2);
end

%DRAWING THE LINES
for i=1:n-2
    y(i,:)=max(0,y(i,:));
    plot(x1,y(i,:),'linewidth',4)
    hold on
```

```
end
hold on
%FINDING THE POINT OF INTERSECTION
pt=[0;0];
for i=1:size(A,1)
    A1=A(i,:);
    B1=B(i,:);
    for j=i+1:size(A,1)
        A2=A(j,:);
        B2=B(j,:);
        A3=[A1;A2];
        B3=[B1;B2];
        %X3=inv(A3)*B3
        X3=A3\B3;
        if(X3>=0)%since the number of chairs can never be negative
            pt= [pt X3];
        end
    end
end

X=pt';
X=unique(X,'rows')%solution
hold on

% KEEP ONLY FEASIBLE POINTS
x1=X(:,1);
x2=X(:,2);

for i=1:n-2 %n=size(A,1)-2
    %for greater than(1) equation we remove A*X'>B and for less than(-1) we do A(i,:)*X'<B(i)
    if(const(i)>0)
        ind=find(A(i,:)*X'>B(i));
        X(ind,:)=[];% indexes that are not satisfying the constraint are being replaced with empty set
    else
        ind=find(A(i,:)*X'<B(i));
        X(ind,:)=[];
    end
end

% EVALUATE THE OBJECTIVE FUNCTION VALUE
if(objective == 1)
    obj_val=c*X';
    [value, ind]=max(obj_val);
    fprintf("The max optimal value is : %f \n",value)
    fprintf("The max optimal point is : (%g,%g) \n",X(ind,:))
else
    obj_val=c*X';
    [value, ind]=min(obj_val);
    fprintf("The min optimal value is : %f \n",value)
    fprintf("The min optimal point is : (%g,%g) \n",X(ind,:))
end
X(ind,:);
Optimal=[X(ind,:) value];


% Shaded feasible region
x=X(:,1);
y=X(:,2);
```

```
scatter(X(:,1),X(:,2),'*')
hold on
k=convhull(x,y);%the shaded region where a and y is satisfied
fill(x(k),y(k),'m')

% setting the axes
xlim([0 max(x)+1])
ylim([0 max(y)+1])

xlabel('x-axis')
ylabel('y-axis')
title('Feasible region of the linear programming problem')
% legend('2x_1+x_2\leq104','x_1+2x_2\leq76','x_1,x_2\geq0')

%phase 7: Verification
x=0:0.1:max(B);
for z=0:0.5:value
    y=(z-c(1)*x)/c(2);
    plot(x,y)
    hold on
    drawnow
    pause(0.001)
end
hold on
```

```
X =

         0         0
         0    1.6000
         0    2.0000
    0.6667    1.3333
    2.0000         0
    4.0000         0

The max optimal value is : 10.000000
The max optimal point is : (2,0)
```



QUESTION 4: Graphical method to solve

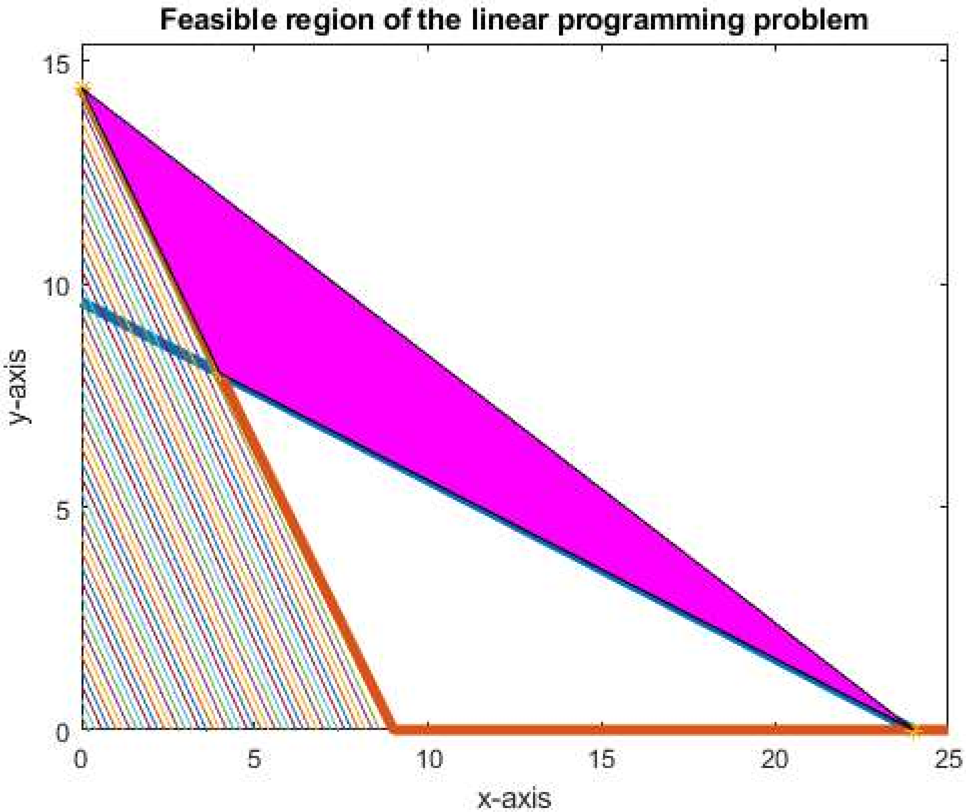
Min Z= 40x1+24x2 20x1+50x2>=480 80x1+50x2>=720 x2>=0 x1>=0

```
clf
clc
clear all
format short
%INPUT PARAMETERS
c=[40,24]; %cost objective function
A=[20,50;80,50;0,1;1,0];
B=[480;720;0;0];
% 1 for <=const and -1 for >= const
const=[-1;-1];%for lesser than function we have 1 and -1 for greater than
objective=-1;%1 for maximization and -1 for minimization
n=size(A,1);
x1=0:0.01:max(B);

for i=1:n-2 %we take n-2 since we are also taking x1=0 and x2=0 as they have no significance in our graph
    y(i,:)=(B(i)-A(i,1)*x1)/A(i,2);
end

%DRAWING THE LINES
for i=1:n-2
    y(i,:)=max(0,y(i,:));
    plot(x1,y(i,:),'linewidth',4)
    hold on
end
hold on
%FINDING THE POINT OF INTERSECTION
pt=[0;0];
```

```
for i=1:size(A,1)
    A1=A(i,:);
    B1=B(i,:);
    for j=i+1:size(A,1)
        A2=A(j,:);
        B2=B(j,:);
        A3=[A1;A2];
        B3=[B1;B2];
        %X3=inv(A3)*B3
        X3=A3\B3;
        if(X3>=0)%since the number of chairs can never be negative
            pt= [pt X3];
        end
    end
end

X=pt';
X=unique(X,'rows')%solution
hold on

% KEEP ONLY FEASIBLE POINTS
x1=X(:,1);
x2=X(:,2);

for i=1:n-2 %n=size(A,1)-2
    %for greater than(1) equation we remove A*X'>B and for less than(-1) we do A(i,:)*X'<B(i)
    if(const(i)>0)
        ind=find(A(i,:)*X'>B(i));
        X(ind,:)=[];% indexes that are not satisfying the constraint are being replaced with empty set
    else
        ind=find(A(i,:)*X'<B(i));
        X(ind,:)=[];
    end
end

% EVALUATE THE OBJECTIVE FUNCTION VALUE
if(objective == 1)
    obj_val=c*X';
    [value, ind]=max(obj_val);
    fprintf("The max optimal value is : %f \n",value)
    fprintf("The max optimal point is : (%g,%g) \n",X(ind,:))
else
    obj_val=c*X';
    [value, ind]=min(obj_val);
    fprintf("The min optimal value is : %f \n",value)
    fprintf("The min optimal point is : (%g,%g) \n",X(ind,:))
end
X(ind,:);
Optimal=[X(ind,:) value];


% Shaded feasible region
x=X(:,1);
y=X(:,2);
scatter(X(:,1),X(:,2),'*')
hold on

k=convhull(x,y);%the shaded region where a and y is satisfied
```

```
fill(x(k),y(k),'m')

% setting the axes
xlim([0 max(x)+1])
ylim([0 max(y)+1])

xlabel('x-axis')
ylabel('y-axis')
title('Feasible region of the linear programming problem')
% legend('2x_1+x_2\leq104','x_1+2x_2\leq76','x_1,x_2\geq0')

%phase 7: Verification
x=0:0.1:max(B);
for z=0:8:value
    y=(z-c(1)*x)/c(2);
    plot(x,y)
    hold on
    drawnow
    pause(0.001)
end
hold on
```

```
X =

         0         0
         0    9.6000
         0   14.4000
    4.0000    8.0000
    9.0000         0
   24.0000         0

The min optimal value is : 345.600000
The min optimal point is : (0,14.4)
```


Feasible region of the linear programming problem
15
10
5
0
0
5
10
15
20
25
y-axis
x-axis