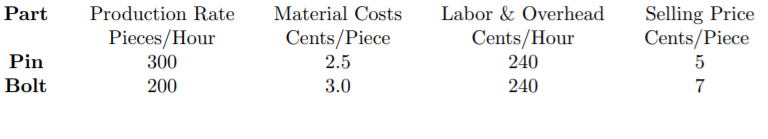
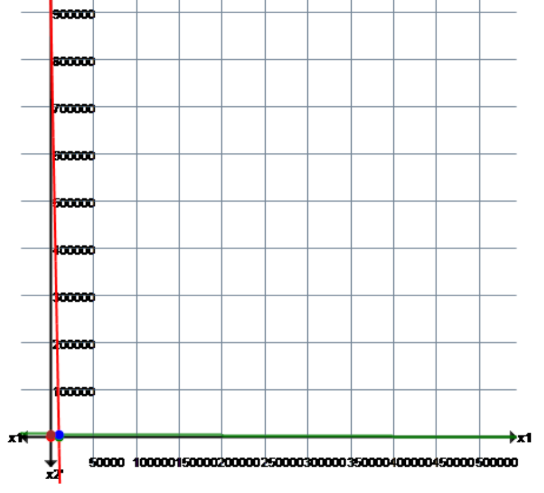
1. A small job shop has one automatic screw machine which can be operated a maximum of 7.5 hours per day. They plan to manufacture both pins and bolts on the machine and they feel that they can sell any amount they can produce of either or both products. However, a maximum of 1000 bolts per day can be produced due to raw material shortages. Other relevant production and cost data are given in the table below:



It is desired to find the quantity of each part to produce per day in order to maximize profit. Please formulate this problem and give a graphical solution. Check with AMPL, LINGO, or whichever program is appropriate. TORA only runs under windows 7 and that is why I did not put on Moodle.

Solution: Using AMPL software

**Step 1: Create Mod file**

#given P=Pin B=Bolt

#Z=maximum profit

**var** P >= 0;

**var** B >= 0;

**maximize** z: 5\*P + 7\*B;

**s.t.** M1: 240\*P + 2.5\*B <=7.5\*300\*1000;

**s.t.** M2: 3\*P + 240\*B <=7.5\*200\*1000;

**step 2 Create Run file**

**reset**;

**model** given.mod;

**option** solver cplex;

**solve**;

**display** P, B , z;

**step 3 run the program you will get the answer below**

ampl: include given.run;

\CPLEX 20.1.0.0: optimal solution; objective 89490.81912

2 dual simplex iterations (1 in phase I)

P = 9311.11

B = 6133.61

z = 89490.8

2. Fred has $2200 to invest over the next five years. At the beginning of each year, he can invest money in one- or two-year time deposits. The bank pays 8 per cent interest on one-year time deposits and 17 per cent (total) on two-year time deposits. In addition, West World Limited will offer three-year certificates starting at the beginning of the second year. These certificates will return 27 percent (total). If Fred reinvests his money available every year, formulate a linear program to show how to maximize his total cash on hand at the end of the fifth year.

Solution: Using AMPL software

**Step 1: create file and input the following program code**

#var represent of year

**var** x{i **in** 1..3, j **in** 1..5} >= 0;

#optimazatin of money per anual of interest

**maximize** money: 1.08\*x[1,5] + 1.17\*x[2,4] + 1.27\*x[3,3];

#number of constraint in the variable

**s.t.** interest1: x[1,1] + x[2,1] <= 5000;

**s.t.** interest2: x[3,1] = 0;

**s.t.** interest3: x[3,4] = 0;

**s.t.** interest4: x[3,5] = 0;

**s.t.** interest5: x[1,2] + x[2,2] + x[3,2] <= 1.08 \* x[1,1];

**s.t.** interest6: x[1,3] + x[2,3] + x[3,3] <= 1.08 \* x[1,2] + 1.17 \* x[2,1];

**s.t.** interest7: x[1,4] + x[2,4] <= 1.08 \* x[1,3] + 1.17 \* x[2,2];

**s.t.** interest8: x[1,5] <= 1.08 \* x[1,4] + 1.17 \* x[2,3] + 1.27 \* x[3,2];

**solve**;

**printf**{j **in** 1..5}:"\n\* %.2f %.2f %2.f \n", x[1,j], x[2,j], x[3,j];

**end**;

**Step 2: run the file by calling “ampl: include given2.run” in the console**

ampl: include given2.run;

MINOS 5.51: optimal solution found.

1 iterations, objective 7429.5

\* 0.00 5000.00 0

\* 0.00 0.00 0

\* 0.00 0.00 5850

\* 0.00 0.00 0

\* 0.00 0.00 0

5850 is the maximum total cash hand

3.A manufacturing firm would like to plan its production/inventory policy for the months of August, September, October and November. The product under consideration is seasonal, and its demand over the particular months is estimated to be 500, 600, 800 and 1200 units respectively. Presently, the monthly production capacity is 600 units with a unit cost of $25. Management has decided to install a new production system with monthly capacity of 1100 units with a unit cost of $30. However, the new system cannot be installed until the middle of November (hint: this timing restriction provides an important bounding criterion on the level of production activity for this month). Assume that the starting inventory is 250 units and that at most 400 units can be stored any given month. If the holding inventory cost per month per item is $3, find the production schedule that minimizes the total production and inventory cost using the AMPL code. Assume that demand must be satisfied and that 100 units are required in inventory at the end of November

i) Please formulate this problem.

ii) Also please solve with AMPL. This is suggested so that you become familiar with the style of inputs required of AMPL.

Solution: AMPL IDLE software

Step 1: program code

#plan its production/inventory policy for the months

clear ; clc ; **close** all

#particular months is estimated

n = input('cost of production ') ;

a=76500

C = input('Cost of holding enventor ' ) ;

h=2850

b = input('Please Enter the elements of sales ' ) ;

b=79350

dett = det(C)

starting inventory **in** given month

**if** dett == 0;

**print**('This system unsolvable because det(C) = 0 ');

**else**;

b = b';

A = [ C b ] ;

**for** j = 1:(n-1);

**for** i= (j+1) : n;

mult = A(i,j)/A(j,j) ;

**for** k= j:n+1;

A(i,k) = A(i,k) - mult\*A(j,k) ;

A;

**end**;

end;

end;

#are required in inventory at the end of November

for p = n:-1:1;

for r = p+1:n;

x(p) = A(p,r)/A(p,r-1);

end;

end;

end;

step 2: result of minimize total cost

total Cost of production 76500

a =

76500

Cost of holding enventor 2850

h =

2850

Please Enter the elements of sales 79350

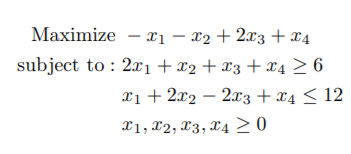
b =

79350

dett =

2850

4. Consider the following problem:



a. Introduce slack variables and draw the requirements space.

b. Interpret feasibility in the requirements space.

c. You are told that an optimal solution can be obtained by having at most two positive variables while all other variables are set to zero. Utilize this statement and the requirements space to find an optimal solution.

Step 1: write program about slack variables and save it slacvar-MATLAB

%2x1+x2+x3+x4>=6;

%x1+2x2-2x3+x4=<12;

%x1,x2,x3,x4>=0

%2x1+x2+x3+x4-s1+0 =6;

%x1+2x2-2x3+x4+0+s2 =12;

%z=-x1-x2+2x3+x4+0+0+z=0;

A=[2,1,1,1,-1,0,6;1,2,-2,1,0,1,12;-1,-1,2,1,0,0,1]

A(1,:)=A(1,:)/A(1,3);A(1,:)=A(1,:)-A(2,:)\*A(1,3); A(3,:)=A(3,:)-A(2,:)\*A(3,3)

Step 2: . Introduce slack variables and draw the requirements space.

>> slackvar

A =

2 1 1 1 -1 0 6

1 2 -2 1 0 1 12

-1 -1 2 1 0 0 1

Step 3 : nterpret feasibility in the requirements space.

A =

1 -1 3 0 -1 -1 -6

1 2 -2 1 0 1 12

-3 -5 6 -1 0 -2 -23

Step 4: the vector Ax=B

(1,6,2)

(1,2,4)

(1,5,7)

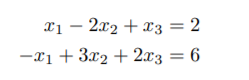
(1,8,9)

z=-x1-x2+2x3+x4

z=-1+2\*8+4

z=19

5. Construct a general solution of the system Ax = b where A is an m × n matrix with rank m. What is the general solution of the following system?



Step 1: using matlab write program in Ax=b

%\ x1-2x2+x3=2

%\ -x1+3x2+2x3=6

A=[1,-2,1;-1,3,2]

B=[2;6]

A\B

Step 2: command window result

>> matrix

A =

1 -2 1

-1 3 2

B =

2

6

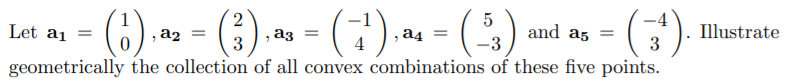
ans =

0

0.2857

2.5714

>> x1=0, x2=0.2857,x3=2.5714

6. 

**solution: Matlab software**

**Step 1: Program to plot the convex combination**

x=[1,2,-1,5,-4]

y=[0,3,4,-3,3]

plot(x,y)

title('convexcombination'),xlabel('x'),ylabel('y')

**Step 2: Program to plot the convex combination**

>> x=[1,2,-1,5,-4]

y=[0,3,4,-3,3]

plot(x,y)

x =

1 2 -1 5 -4

y =

0 3 4 -3 3

>> x=[1,2,-1,5,-4]

y=[0,3,4,-3,3]

figure, plot(x,y)

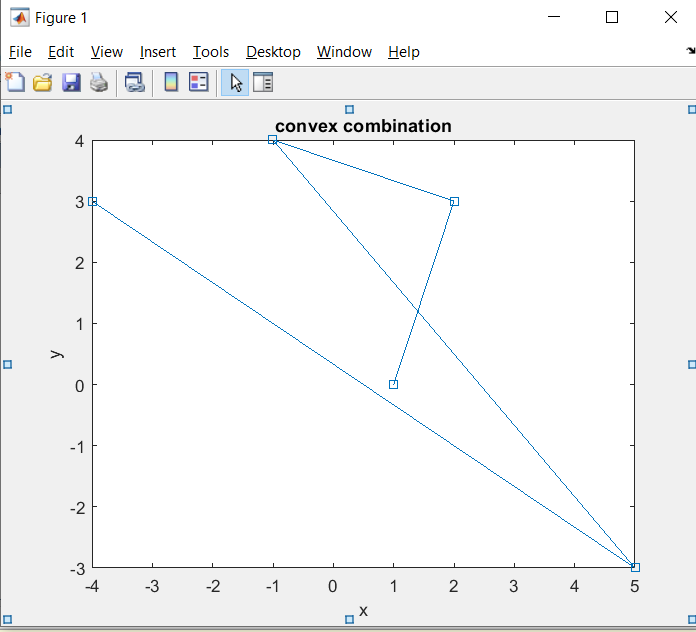
x =

1 2 -1 5 -4

y =

0 3 4 -3 3

>> title('convex combination'),xlabel('x'),ylabel('y')



7. Find all the extreme points of the following polyhedral set



Does X have any recession directions? Why? (AMPL, Matlab, Mathematica, Python, or Maple may be helpful here)

**Solution: Matlab software**

Step 1: write the function of matlab

function [A,B]=index(x,b);

A=[1,0,0;1,-1,1;1,-2,0]

B=[0;1;4]

fprintf( 'PointA= [0,0,0]\n PointB= [0,0,1] \n PointC= [1,0,0]\n')

%using the increament of augmented matrix

%Ax+b

for i=1:2:B;

A/B;

hum=I-x^2/x4;

man>=4;

tabchanges =[1,0,0;1,-1,1;1,-2,0];

x>=0;

A<=0;

%percent of x>=0 if I>x^2

End

**Step 2: Run the program having point of PointA= [0,0,0] PointB= [0,0,1] PointC= [1,0,0]**

>> index

A =

1 0 0

1 -1 1

1 -2 0

B =

0

1

4

PointA= [0,0,0]

PointB= [0,0,1]

PointC= [1,0,0]