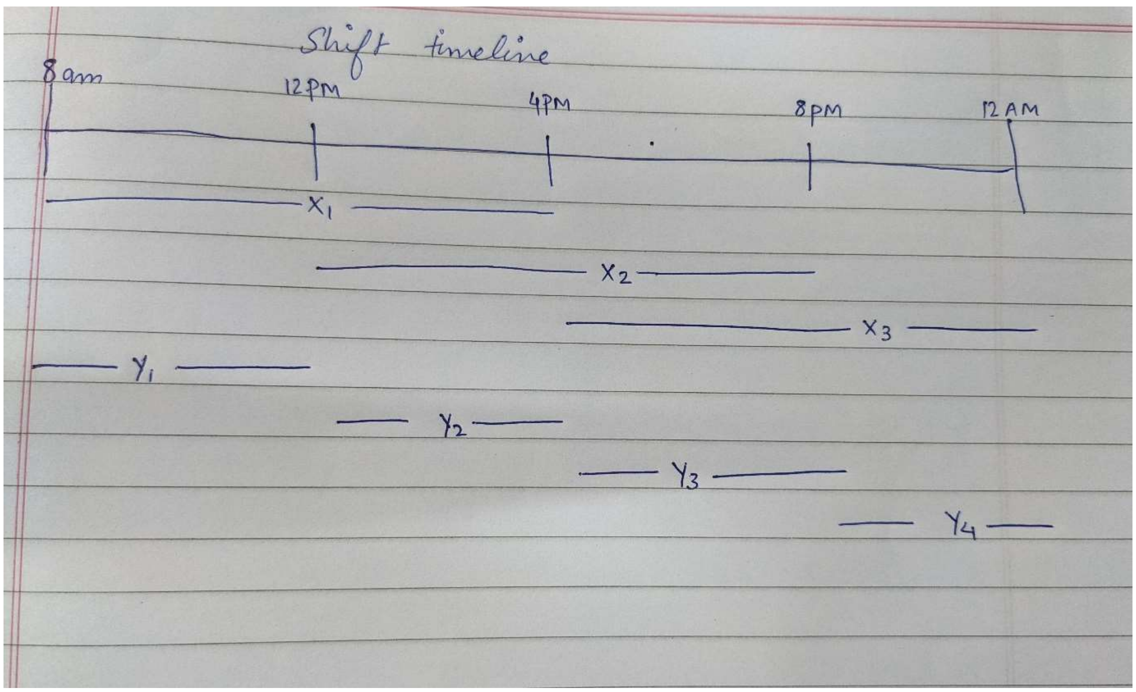
Assignment 2

Problem 1:

Decision Variables:

The Decision variables in this problem are the number of full-time and part time consultants per shift.



X_i = Number of full-time consultants to work shift (i =1,2,3)

1 = 8am to 4pm, 2 = 12pm to 8pm, 3 = 4pm to 12am

Y_i = Number of part-time consultants to work shift (i = 1,2,3,4)

1 = 8am to 12pm, 2 = 12pm to 4pm, 3 = 4pm to 8pm, 4 = 8pm to 12am

Objective Function:

The objective function is to minimize the cost function:

Minimize: $Z = 112(X_1+X_2+X_3) + 48(Y_1+Y_2+Y_3+Y_4)$

Subject to Constraints:

$X_1+Y_1 \geq 4$

$X_1+X_2+Y_2 \geq 8$

$X_2+X_3+Y_3 \geq 10$

$X_3+Y_4 \geq 6$

$X_1, X_2, X_3 \geq 0$

$Y_1, Y_2, Y_3, Y_4 \geq 0$

$X_1 \geq Y_1$

$X_1+X_2 \geq Y_2$

$X_2+X_3 \geq Y_3$

$X_3 \geq Y_4$

<u>Decision Variables:</u>

The decision variables in this problem are number of full-time (with meal breaks) and part-time (no meal breaks) consultants per shift:

As only full-time consultants get meal break during the 8 hours shift:

$14*7hrs =$98 per shift (Reduced 1 hour from total shift time).

Problem 2:

Xi = Units of i backpack produced per week (i=1,2)

1 = Collegiate Backpack, 2 = Mini Backpack

Maximize: $Z = 32*X_1+24*X_2$

Subject to:

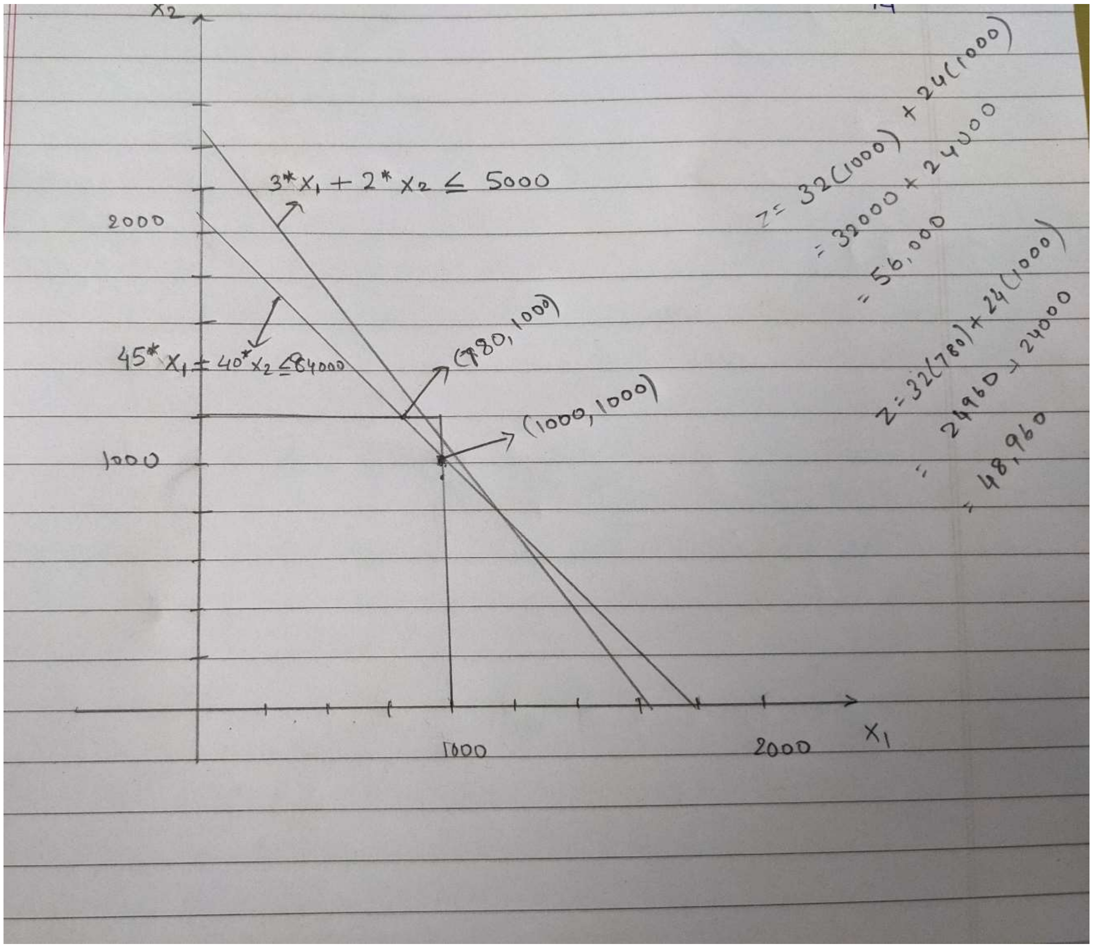
$3*X_1+2*X_2 \leq 5000$

$45*X_1+40*X_2 \leq 84000$

And:

$0 \leq X_1 \leq 1000$

$0 \leq X_2 \leq 1200$



Plugging values into objective function ($Z = 32*X_1+24*X_2$)

(1000,1000) => Z = 56,000

(780, 1000) => Z = 48,960

Therefore, the optimal solution for this problem is to produce:

1000 Collegiate backpack per week

1000 Mini backpack per week

Problem 3

A) Decision Variables:

X i,j = Number of units of product j produced at Plant i(i= 1,2,3)(j= 1,2,3)

i = 1 (Plant 1), i = 2 (Plant 2), i = 3 (Plant 3)

j = 1 (Large), j = 2 (Medium), j = 3 (Small)

B) Linear Programming Model:

Objective Function:

Maximize Profits: $Z = 420(X_{1,1} + X_{2,1} + X_{3,1}) + 360(X_{1,2}+X_{2,2}+X_{3,2}) + 300(X_{1,3}+X_{2,3}+X_{3,3})$

Subject to Constraints:

Capacity Constraints (Production):

$X_{1,1} + X_{1,2} + X_{1,3} \leq 750$

$X_{2,1} + X_{2,2} + X_{2,3} \leq 900$

$X_{3,1} + X_{3,2} + X_{3,3} \leq 450$

Storage Constraints:

$20*X_{1,1} +15* X_{1,2} +12* X_{1,3} \leq 13,000$

$20*X_{2,1} + 15*X_{2,2} + 12*X_{2,3} \leq 12,000$

$20*X_{3,1} +15*X_{3,2} +12*X_{3,3} \leq 5,000$

Sales Constraints:

$X_{1,1} + X_{2,1}+ X_{3,1} \leq 900$

$X_{1,2} + X_{2,2}+ X_{3,2} \leq 1200$

$X_{1,3} + X_{2,3}+ X_{3,3} \leq 750$

Equal Capacity Usage:

$$\underbrace{(X_{1,1} + X_{1,2} + X_{1,3})}_{750} = \underbrace{(X_{2,1} + X_{2,2} + X_{2,3})}_{900}$$

$$\underbrace{(X_{2,1} + X_{2,2} + X_{2,3})}_{900} = \underbrace{(X_{3,1} + X_{3,2} + X_{3,3})}_{450}$$

Equal capacity usage constraint:

$900(X_{1,1} + X_{1,2} + X_{1,3}) – 750\ (X_{2,1} + X_{2,2} + X_{2,3}) = 0$

$450(X_{2,1} + X_{2,2} + X_{2,3}) – 900\ (X_{3,1} + X_{3,2} + X_{3,3}) = 0$

$450((X_{1,1} + X_{1,2} + X_{1,3}) – 450(X_{3,1} + X_{3,2} + X_{3,3}) = 0$

Non-Negative Boundary:

$X_{1,1}, X_{1,2}, X_{1,3}, X_{2,1}X_{2,2}, X_{2,3}, X_{3,1}, X_{3,2}, X_{3,3} \geq 0$