Linear Programming

1) A Person wants to decide the constituents amount of diet which will fulfill his daily requirements of Protiens,Fats and Carbohydrates at a Minimum cost. The choice is to be made from four different types of foods. The yields per unit of those food are given below. Formulate Linear programming Model

Food type	Yield per unit			Cost per unit (Rs)
	Proteins	Fats	Carbohydrates	
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	4	65
Minimum Requirement	**800**	**200**	**700**	

Solution:

Let X_1 Amount of Type1 food to be taken, Let X_2 Amount of Type2 to be taken, Let X_3 Amount of Type3 to be taken, Let X_4 Amount of Type4 to be taken,

Z_{min} = $45X_1 + 40X_2 + 85X_3 + 65X_4$ ----Objective Equation

$3X_1 + 4X_2 + 8X_3 + 6X_4 >= 800$ [Protein constrain]

$2X_1 + 2X_2 + 7X_3 + 5X_4 >= 200$ [Fats constrain]

$6X_1 + 4X_2 + 7X_3 + 4X_4 >= 700$ [Carbohydrates constrain]

$X_1 >= 0$, $X_2 >= 0$, $X_3 >= 0$, $X_4 >= 0$ { Non negative Constrain}

Linear Programming

1) Old Hens can be bought for Rs. 300 each , Young one cost Rs. 500 each, Old Hen lay 3 eggs per week and young ones lay 5 eggs per week, Each egg being worth 6 Rs. A hen costs of Rs. 15 for feed. If a person has only 15000 to spend on the hens, How many of each kind should he buy to get a profit of more than 600 Rs. Per week Assuming that he cannot house more than 30 hens.Formulate Linear programming Model

Solution:

Let X be the number of Old Hens to be brought,

Let Y be the number of Young Hens to be brought

	Old Hen	Young Hen
Cost	300	500
Egg	3 Egg per week	5 Egg per week
Feed	15 Rs.	15 Rs.
Each Egg Selling price	6	6

since objective was not defined, i.e max. profit or minimize cost..we calc. profit by this

Z_{Max} = SP-CP=

=(6*3)X+(6*5)Y -15*X-15*Y {15* X indicate feed}

=18X+30Y-15X-15Y

Z_{Max}=3X+15Y ----Objective Equation

300X+500Y <= 15000 [Cost constrain]

X+Y <= 30 [Space constrain]

X>=0,Y>=0 [Non Negative]

3X+15Y >=600 [Income Constrain]

Linear Programming

1) A farmer has a 100 acre farm, He can sell all the Tomatoes,Onion, Radishes he can raise, The price he can obtain is Rs.5 per kg Tomatoes, Rs.10 per kg Onion,Rs. 8 per kg for Radish,The average yield per acre is 2000 kg of Tomatoes,3000 kg Onion,1000 kg of Radish, Fertilizer is available at RS.5 per Kg, Amount of fertilizer require for each Tomatoe,Onion-100 Kg per acre,50 Kg for Radish,Labour require for cultivating per ace is 5 man day for Tomatoes,6 man day for Onion,5 man day for Radish. A total 400 mans are available at Rs.500 per day. Formulate Linear programming Model.

Solution:

	Tomatoes	Onion	Radish
Selling Price	Rs.5 per kg	Rs.10 per kg	Rs. 8 per kg
Yield	2000kg/Acre	3000kg/Acre	1000kg/Acre
Fertilizer	100kg/Acre	100kg/Acre	50kg/Acre
Cultivating	5 Man/Acre	20 Man/Acre	5 Man/Acre

Fertilizer rate: 5 Rs/kg

Each Labour Cost: Rs.500 per Day

X_1	X_2	X_3

Let X_1 be the number of acres to be used for growing Tomatoe.

Let X_2 be the numbe of acrs to be used for growing Onion.

Let X_3 be the numbe of acrs to be used for growing Radishes.

Z_{max} =(2000*5) X_1 + (3000*10) X_2 + (1000*8) X_3 – (100*5) X_1 -(100*5) X_2 – (50*5) X_3 –(500*5) X_1 –(20*500) X_2- (500*5) X_3

profit= SP-CP

$=10000X_1 + 30000\ X_2 + 8000\ X_3 - 500\ X_1 - 500\ X_2 - 250\ X_3 - 2500\ X_1 - 10000\ X_2 - 2500\ X_3$

$Z_{max} =$ $7000\ X_1 + 19500\ X_2 + 5250\ X_3$ { Objective equation }

Constrains:

$5\ X_1 + 20\ X_2 + 5\ X_3 <= 400$ {Labour Constrain}

$X_1 + X_2 + X_3 <= 100$ { Land Constrain}

$X_1 >= 0,\ X_2 >= 0,\ X_3 >= 0$ { Non negative Constrain }

2) A hospital has the following minimal daily requirement of nurses

Period	Clock time	Minimal Number of Nurses Requaired
1	6 AM to 10 AM	2
2	10 AM to 2 PM	7
3	2 PM to 6 PM	15
4	6 PM to 10 PM	8
5	10 PM to 2 AM	20
6	2 AM to 6 AM	6

Nurses report to the hospital at the beginning of each period and work for 8 consecutive hours. The hospital wants to determine the minimal number of nurses to be employed so that there is sufficient number of nurses available for each period. Formulate this as Linear programming problem

Solution:

Let $X_1, X_2, X_3, X_4, X_5, X_6$ number of nurses to be appointed for period 1,2,3,4,5,6 respectiveley.

Objective equation: $Z_{min} = X_1 + X_2 + X_3 + X_4 + X_5 + X_6$

Constrains

$X_1 + X_2 >= 7$

$X_2 + X_3 >= 15$

$X_3 + X_4 >= 8$

$X_4 + X_5 >= 20$

$X_5 + X_6 >= 6$

$X_6 + X_1 >= 2$

$X_1 >= 0$, $X_2 >= 0$, $X_3 >= 0$, $X_4 >= 0$, $X_5 >= 0$, $X_6 >= 0$,

Linear Programming

1) Consider the following problem faced by a production planner in a soft drink plant. He has 2 bottling machines A and B. A is assigned for 8-ounce bottle and B is assigned for 16-ounce bottle. The following data are available

Machine A	8ounce bottle	16ounce bottle
A	100/ Minute	40/Minute
B	60/Minute	75/Minute

The machines can be run for 8-hours per day,5 days a week, Profit on 8 ounce bottle is 15 paise and on 16 ounce bottle is 25 paise. Weekly production of the drink cannot exceed 300000 ounces and the market can obserb 25000 eight ounce bottle and 7000 sixteen ouce bottles per week. The planner wishes to maximize his profit,of course,to all the production and marketing constrains. Formulate Linear programming model.

Solution

Let X_1 be the number of 8 Ounce bottle to be produced on Machine A, X_2 be the number of 16 ounce bottle to be produced on Machine A.
Let Y_1 be the number of 8 ounce bottle to be produced on B, Y_2 be the number of 16 ounce bottle to be produced on B.

$Z_{max} = (X_1 + Y_1)\ 0.15 + (X_2 + Y_2)0.25$ [Objective equation]

1 Min----100 products then 1 product $\frac{1}{100}$ duration requires

Similarley for X_1 products $\frac{X_1}{100}$ [8 Ounce bottles]