

Course: UMA 035 (Optimization Techniques)

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Need of LPP and NLPP in real-life problems

A company has two grades of inspectors, I and II, who are to be assigned for a quality Control inspection. It is required that at least 2000 pieces be inspected per 8 hour day. Grade I inspectors can check pieces at the rate of 50 per hour with an accuracy of 97%. Grade II inspectors can check pieces at the rate of 40 per hour with an accuracy of 95%. The wage rate of grade I inspector is Rs. 4.50 per hour and that of grade II is Rs. 2.50 per hour. Each time an error is made by an inspector , the cost to the company is Rs. 2.00. The company has available for inspection job, 10 grade I and 5 grade II inspectors. Formulate the problem (DO NOT SOLVE) to minimize the total cost of inspection.

Let x_1 inspectors of grade I and x_2 inspectors of grade II should be assigned.

Then,

First Constraint is : $x_1 \leq 10$ and $x_2 \leq 5$, $x_1 \geq 0$, $x_2 \geq 0$, x_1 is an integer, x_2 is an integer

No. of pieces checked by one inspector of grade I in one hour = 50

No. of pieces checked by one inspector of grade I in 8 hour = $50 \times 8 = 400$

No. of pieces checked by x_1 inspectors of grade I in 8 hour = $400 \times x_1$

No. of pieces checked by one inspector of grade II in one hour = 40

No. of pieces checked by one inspector of grade II in 8 hour = $40 \times 8 = 320$

No. of pieces checked by x_2 inspectors of grade II in 8 hour = $320 \times x_2$

Total pieces checked in 8 hour = $400 \times x_1 + 320 \times x_2$

Second Constraint is : $400 \times x_1 + 320 \times x_2 \geq 2000$

**Number of pieces wrongly checked by x_1 inspectors of grade I in 8 hour =
 $(400 * x_1) * (3/100)$**

**Number of pieces wrongly checked by x_2 inspectors of grade I in 8 hour =
 $(320 * x_2) * (5/100)$**

Total pieces checked wrongly = $(400 * x_1) * (3/100) + (320 * x_2) * (5/100)$

Extra cost for one wrongly checked piece = Rs. 2

**Extra cost for $(400 * x_1) * (3/100) + (320 * x_2) * (5/100)$ wrongly checked piece =
 $2 * ((400 * x_1) * (3/100) + (320 * x_2) * (5/100))$**

Wage of one inspector of grade I for one hour = Rs 4.50

Wage of one inspector of grade I for 8 hour = $4.50 * 8$

Wage of x_1 inspectors of grade I for 8 hour = $4.50 * 8 * x_1$

Wage of one inspector of grade II for one hour = Rs 2.50

Wage of one inspector of grade II for 8 hour = $2.50 * 8$

Wage of x_2 inspectors of grade II for 8 hour = $2.50 * 8 * x_2$

Total Cost = $4.50 * 8 * x_1 + 2.50 * 8 * x_2 + 2 * ((400 * x_1) * (3/100) + (320 * x_2) * (5/100))$

Objective function

Minimize $(4.50 * 8 * x_1 + 2.50 * 8 * x_2 + 2 * ((400 * x_1) * (3/100) + (320 * x_2) * (5/100)))$

LPP

Minimize $(4.50*8* x_1+2.50*8* x_2+2*((400* x_1)*(3/100)+(320* x_2)*(5/100)))$

Subject to

$$400* x_1+320* x_2 \geq 2000$$

$x_1 \leq 10$ and $x_2 \leq 5$, $x_1 \geq 0$, $x_2 \geq 0$, x_1 is an integer, x_2 is an integer

A company manufacturing TV and Radio sets has four major departments, chassis, cabinet, assembly and final testing. Monthly capacities are:

Capacity →	TV	Radio
Departments ↓		
Chassis	2500 or 4500	
Cabinet	2000 or 8000	
Assembly	3000 or 4000	
Final Testing	4500 or 9000	

The profit per TV set is Rs. 250 and that of a radio set is Rs. 50. Assuming that the company can sell any quantity of either product, determine the optimal combination of output. Formulate it as Linear programming problem.

Let x_1 TV and x_2 radio.

Then,

First Constraint: $x_1 \geq 0$ and $x_2 \geq 0$, x_1 is an integer, x_2 is an integer.

Time required for chassis for 2500 Tv = 1 month

Time required for chassis for 1 Tv = $1/2500$ month

Time required for chassis for x_1 Tv = $x_1/2500$ month

Time required for chassis for 4500 Radio= 1 month

Time required for chassis for 1 Radio = $1/4500$ month

Time required for chassis for x_2 Radio = $x_2/4500$ month

Total time for chasis for TV and Radio <= 1 month

$$x_1/2500 \text{ month} + x_2/4500 \text{ month} \leq 1 \text{ month}$$

First constraint: $x_1/2500 + x_2/4500 \leq 1$

Second constraint: $x_1/2000 + x_2/8000 \leq 1$

Third constraint: $x_1/3000 + x_2/4000 \leq 1$

Fourth constraint: $x_1/4500 + x_2/9000 \leq 1$

Profit on one TV=Rs 250

Profit on x_1 TV =250 x_1

Profit on one Radio=Rs 50

Profit on x_2 Radio =50 x_2

Total Profit=250 $x_1+50 x_2$

Objective : Maximize $(250 x_1+50 x_2)$

LPP

Maximize $(250 x_1+50 x_2)$

Subject to

$$x_1/2500 + x_2/4500 \leq 1$$

$$x_1/2000 + x_2/8000 \leq 1$$

$$x_1/3000 + x_2/4000 \leq 1$$

$$x_1/4500 + x_2/9000 \leq 1$$

$x_1 \geq 0$ and $x_2 \geq 0$, x_1 is an integer, x_2 is an integer

A company produces two types of hats. Type 1 requires twice as much labour time as type 2 alone. If all labour time is dedicated to type 2 alone, the company can produce a total of 400 hats of type 2 per day. Respective market limits for two types are 150 and 200 per day. The profit is Rs. 8 per type 1 hat and Rs. 5 per type 2 hat. Find the optimum number of hats to be prepared so that it maximizes company's profits.

Let x_1 hats of type 1 and x_2 hats of type 2 Then

First Constraint: $x_1 \geq 0, x_2 \geq 0, x_1$ is an integer, x_2 is an integer

Time required for producing one hat of type 1 = 2* time required for producing one hat of type 2

Let time required for producing one hat of type 2 = t

Then,

Time required for producing one hat of type 1 = 2t

Time for producing 400 hats of type 2= $400*t$ (Time for whole day)

Time required for producing one hat of type 1+ time required for producing one hat of type 2 \leq Time for whole day

$x_1 2t + x_2 t \leq 400t$ i.e., Second constraint: $2x_1 + x_2 \leq 400$

Profit on one hat of type I=8

Profit on x_1 hats of type I = 8 x_1

Profit on one hat of type II=5

Profit on x_2 hats of type I = 5 x_2

Total Profit= 8 $x_1+5 x_2$

Objective: Maximize (8 $x_1+5 x_2$)

LPP

Maximize (8 $x_1+5 x_2$)

Subject to

$2x_1+x_2 \leq 400$

$x_1 \leq 150$

$x_2 \leq 200$

$x_1 \geq 0, x_2 \geq 0, x_1$ is an integer, x_2 is an integer