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OPTIMUM UTILIZATION OF RESOURCE BY USING LINEAR PROGRAMMING TECHNIQUE

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Abstract **-** *Every organization faces the problem of allocation of resources. The resources include men, machine, material, and capital. Most of these decisions are made subject to constraints. For example, production from a factory is limited due to capacity constraints, and an organization faces working capital constraints and technical constraints. However, if the available resources cannot be expanded, then optimal utilization of existing resources becomes very important task for the organization. Therefore, this paper deals with the idea of optimum utilization of resources to increase the production of toys and hence the profit. In order to achieve this, a technique of linear programming is used. This technique will maximize the profit in production of toys by optimum use of resources. This paper also discusses four important conditions related to productions and their results are tabulated in their respective tables. Firstly the condition of nil production is discussed after that second, third and fourth condition shows the allocation of resources in such a way that continuous increase in profit is achieved. After detailed analysis summary of mathematical results obtained are also tabulated.*

Keywords: *Optimization, Resources, LPP*

[1] INTRODUCTION

Linear programming is one of the most versatile, popular and widely used quantitative techniques. A linear programming model offers an efficient method for determining an optimal decision (or an optimal strategy or an optimal plan) chosen from a large number of possible decisions. The optimal decision is one that meets a specified objective or management, subject to various constraints and restrictions [1].

[2] PROBLEM STATEMENT

Generally production from companies is limited because of many constraints such as capacity, working capital and technical reasons.

[3] METHODOLOGY

In order to solve the problem of limited production of electronic toys in any company it is mandatory that resources should be allocated in such a way that maximum production is obtained. This can easily be done by using linear programming. For this work mathematical approach is applied. It is assumed here that there are three machines. The three machines viz. M_1, M_2 and M_3 should be adjusted in such a way that maximum profit is achieved. This is possible only if machines are utilized to its full capacity i.e. when idle time is zero. It is assumed that there are two types of toys "A" and "B" respectively. Their machine capacity and number of products produced are X_1 of type A and X_2 of type B and governed by following relation:

Machine

M1 $X_1+2X_2 \leq 720$ (1)

M2 $2X_1+2X_2 \leq 780$ (2)

M3 $X_1 \leq 320$ (3)

The first step in this direction is to write inequality in the form of equality equation. This can be done by adding

variables S_1, S_2 and S_3 on LHS from the pocket.

$$Z= 60X_1+40X_2$$

$$X_1+2X_2 +S_1= 720 \quad (4)$$

$$2X_1+X_2 +S_2= 780 \quad (5)$$

$$X_1+S_3= 320 \quad (6)$$

First of all a trivial solution is tried i.e. X_1 and X_2 both equal to zero. It will give

$S_1=720$ $S_2=780$ $S_3=320$

Profit is always nil when there is no production i.e

$X_1=0$ And $X_2=0$

. i.e. all resources are idle.

Now solution is to be developed in such a manner that gives a combination of minimum value of S_1, S_2, S_3 and in turn will maximize the value of objective function Z [2].

In this problem numbers of unknowns are five and numbers of equations are three. So value of at least two

Variables is to be supplied from the pocket. Such variables are called assigned variable.

[4] RESULTS AND DISCUSSIONS

4.1 Situation of no production

Now to begin with, consider a situation of no production. This will yield value of S_1, S_2, S_3, as 720,780 and 320 respectively. Such situation is not desirable as it gives no profit. So production has to be done for the survival of the unit. The inspection of objective function clearly tells that production of X_1 yields more profit than X_2. Now first step of attack strategy will be to determine maximum production capacity of the unit as a whole. Naturally this value will be minima of the maxima produced by individual machine. To obtain this value take production of X_1 as nil.

Production of X_1 by first machine 720/1 = 720

Production of X_1 by second machine 780/2 = 390

Production of X_1 by third machine 320/1 = 320

So least of 720, 390, 320 is 320.

Now what will happen if 320 numbers of X_1 is produced:

$X_1=320$
$X_2=0$
$S_1=400$
$S_2=140$
$S_3=0$

The above information can be presented in tabular form (Table 1).

Table 1 Situation of no Production

		Cj	60	40	0	0	0
C_B	Basic Variables B	Solution Values b	X_1	X_2	S_1	S_2	S_3
0	S1	720	1	2	1	0	0
0	S2	780	2	1	0	1	0
0	S3	320	1	0	0	0	1
		Zj	0	0	0	0	0
Cj-Zj			60	40	0	0	0

4.2 Situation of production when profit is 19200

Since production of X_1 gives more profit, it is best to produce X_1 first. Now by manipulating equations (4), (5),and (6) following equations can be obtained.

By manipulating Eq. (4) and Eq. (6)

$0X_1+2X_2+1S_1+0S_2-1S_3=400$

By manipulating Eq. (5) and Eq. (6)

$0X_1+1X_2+0S_1+1S_2-2S_3=140$

Equation (6) is retained as it is

$1X_1+0X_2+0S_1+0S_2+1S_3=320$

These results have been summarized as given in Table 2.

Table 2 Situation of Production when Profit is19200

		Cj	60	40	0	0	0
C_B	Basic Variables B	Solution Values b	X_1	X_2	S_1	S_2	S_3
0	S_1	400	0	2	1	0	-1
0	S_2	140	0	1	0	1	-2
60	X_3	320	1	0	0	0	1
	Zj	19200	60	0	0	0	6
Cj-Zj			0	40	0	0	-6

4.3 Situation of production when profit is 24800

The inspection of Table 2 shows that profit has improved from nil to 19200.

Now it is clear that resource S_1 and S_2 are available for production.

S_1 resource is available 200 number of product X_2 while S_2 resource is available for 140 numbers X_2.

So maximum quantity of X_2 can be produced is only 140. X_1 is already being produced to its full capacity.

Now this situation can be stated as under:

$X_1=320$
$X_2=140$
$S_1=120$
$S_2=0$
$S_3=0$

Profit Z = 24800

So profit has improved from 19200 to 24800. So this strategy is better than previous one. This situation of production can be written in tabular form as given in Table 3

Table 3 Situation of Production when Profit is24800

		Cj	60	40	0	0	0
C_B	Basic Variables B	Solution Values b	X_1	X_2	S_1	S_2	S_3
0	S_1	120	0	2	1	-2	3
40	X_2	140	0	1	0	1	-2
60	X_3	320	1	0	0	0	1
	Zj	24800	60	40	0	4	-2
Cj-Zj			0	0	0	-4	2

4.4 Situation of production when profit is25600

The Inspection of Table 3 shows that still resource S_1 of 120 unit is available for production.

Now exploit this resource to full extent i.e. Make S1=0

This row will yield the relation

$S_1-2S_2+3S_3=120$

Now examine the position of resource of S_3. Dividing the above relation by 3 we get

$$\frac{1}{3S1} - \frac{2}{3S2} + S3 = 40$$

In the state of production resource S_1, S_2, S_3 are connected with relation

If S_1 and S_2 are fully exhausted i.e. $S_1=0$ and $S_2=0$, then $S_3 = 40$. This shows that 40 units of S_3 resource will be left unused.

Now solve first constraint (Eq. 4) and second constraint (Eq. 5) after putting S_1 and S_2 equal to zero.

$X_1+2X_2+S_1= 720$

$2X_1+X_2+S_2= 780$
$X_1+2X_2 = 720$
$2X_1+X_2 = 780$

This relation yields

X_1=280
X_2=220
Putting these results in third constraint (Eq. 6)
X_1+S_3= 320 yields
S_3=40
Now the whole exercise can be summarized in tabular form as given in Table 4.

Table 4 Situation of Production when Profit is 25600

Cj			60	40	0	0	0
C_B	Basic Variables B	Solution Values b	X_1	X_2	S_1	S_2	S_3
0	S_3	40	0	2	1/3	-2/3	1
40	X_2	220	0	1	2/3	-1/3	0
60	X_3	280	1	0	-1/3	2/3	0
	Zj	25600	6	4	2/3	8/3	0
Cj-Zj			0	0	-2/3	-8/3	0

In Cj-Zj row coefficient of the variables are either zero or negative this clearly shows that profit has been
maximized. If still, the profit has to be maximized then, enhance resource S_1 and S_2 as long as 40 units of idle S_3 resource is exhausted.

4.5 Summary of Analysis of Linear Programming

Table 5 Summary of the Results (Mathematical Solution)

Sr. No.	Product produced X_1	Product produced X_2	Remaining resource S_1	Remaining resource S_2	Remaining resource S_3	Profit in rupees
1	320 Units	0 Units	400 Units	140 Units	0 Units	1920
2	320 Units	140 Units	120 Units	0 Units	0 Units	2480
3	280 Units	220 Units	0 Units	0 Units	40 Units	2560

[5] CONCLUSIONS

Using the technique of linear programming, the resources are adjusted in such a way that maximum profit in production of toys under given constraints can be achieved. Table 5 shows that maximum profit of 25600 is obtained when production of X_1 = 280 units, X_2 = 220 units and resources S_1 and S_2 are fully exhausted but S_3=40 (meaning 40 units of S_3 resource will be left unused). Therefore, it can be concluded that this is the best strategy under given constraints and hence maximum profit in production of toys can be achieved. Thus the technique of linear programming suggests the ways of reducing the production cost by maximizing the utilization of fixed resources and optimizing the use of variable resources like material and capital with the ultimate aim to increase the profit of the organization. When total production is enhanced, then per unit cost falls and it will enhance the profit and entrepreneur will try to increase the production as long as marginal cost is equal to marginal revenue.

[6] FUTURE SCOPE

The suggested solution is mathematical solution and can easily be computed. Further improvement in optimal solution can be obtained as long as difference between old profit and new profit is a negative value. Computer Networks, Enterpreneurship & Optimization techniques.

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