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Application of Linear Programming Model in Small Scale Industry

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Abstract : *A study was conducted to observe the different constraints in the production of notebooks by a small scale industry in Patna due to scarcity of different resources such as raw materials, labor hours, machine hours and restrictions in marketing. An attempt has been made to apply Linear Programming technique to achieve maximum profit by fulfilling all constraints in production process of this product mix industry.*

Keywords : *product mix industry, linear programming, decision variables ,objective function, feasible solution.*

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Introduction:

Almost every business and economic situations are concerned with a problem of planning activity. In every case , there are limited resources at our disposal and our problem is to make a proper use of resources so as to give the maximum profit or yield the maximum production. These problems are referred as the problem of constraint optimization. Linear Programming(LP) is a technique for determining an optimum schedule of independent activities in the view of available resources (Swarup et al.,2015).

A general linear programming includes a set of simultaneous linear equation(or inequalities) which represent the condition of the problem and a linear function which expresses the objective function of the problem (Prasad,2014).

The word programming in LP refers to the mathematical modeling of LPP. It has nothing to do with computer programming. Interestingly LP is a favorite tool in hands of Operation Research professionals because it is simple, easy to understand and robust. Here robust means it is perfect for nothing but good enough for everything. Unfortunately no real world problems are close enough to linear problem. It is precisely for the reason and in this context that LP is good enough for everything (Chandrashekhar, 2016).

A method of linear programming in general was worked out in 1947 as a result of scientific work of Dantzig. Since then the application of linear programming has spread rapidly and today it is perhaps the most effective mathematical tool that can be applied to the solution of economic and industrial problems (Prasad, 2014).

Many researchers have worked on this topic before (Modibbo et al. 2015; Darquennes 2017). Both of them applied simplex method for solving linear programming problem of resources allocation in product mix industry. In this project the graphical approach for finding the solution of LPP has been used. The conclusions draw from all these researches can be used as a guideline by the respective industries for achieving the optimum profit level.

Materials and Methods:

The jurisdiction of our research was confined to the area of Patna. The data were collected from the different areas of Patna. And these areas were Saraswati Book Depo situated at Nawab Bahadur Road (say branch A), Malvika Vidya Kendra at Ashok Rajpath (say branch B) and Rajnish Stationary at Khazanchi Road (say branch C). These production units(A,B and C) used to produce two types of notebooks of type M and N and supply them to big marketing shops with certain terms and conditions. And also, these production units used to manufacture notebooks on weekly basis. The marketing strategy of the company is to ensure reduction in the selling price per unit of notebooks as the number of paper sheets used in each notebook increases. This was designed to encourage wholesale purchase of the notebook by the user.

Data were collected to observe the different constraints in the production of notebook. Data were collected on raw materials, labor hours and machine hours.

In manufacturing, each unit of the notebook, information on quality of raw material was obtained. Data regarding the profit that the industry gains by selling each notebook were also obtained. However, information regarding one or two raw materials having lesser price like thread or the glue used for sewing the sheets and pasting the cover respectively were not obtainable and their effects were ignored in the analysis. Therefore, the only cost element considered for notebook production in this paper was the labor hour, machine hour and the raw material used.

Results and Discussion:

The value of different constraints for the production of per unit notebook which were obtained for branch A, B and C are shown in the Table 1:

Table 1. Observation obtained for branch A, B and C regarding raw materials and profit coefficients

Branch	Constraints	Notebook (M)	Notebook (N)
A	Profit	Rs 4	Rs 10
	Mach.(hr)	5 min	5 min
	Sheets(Qr)	1	2
	Labor(hr)	15 min	20 min
B	Profit	Rs 4	Rs 8
	Mach.(hr)	8 min	8 min
	Sheets(Qr)	1	2
	Labor(hr)	16 min	24 min
C	Profit	Rs 5	Rs 12
	Mach.(hr)	9 min	9 min
	Sheets(Qr)	1	2
	Labor(hr)	18 min	27 min

Total weekly availability of raw material, labor hour and machine hour which were collected from the data of the industry are shown in Table 2.

Table 2. Observation for availability of Restricted Resources for branch A, B and C.

Constraints	Branch(A)	Branch(B)	Branch(C)
Sheets(Qr)	300	320	360
Labor(hr)	3000	4000	3600
Mach.(hr)	1000	1600	2700

Table 3. Objective functions and the constraint functions for the three branches A,B and C

Branch	Objective fun.	Constraint fun.
A	Z = 4x + 10y	X+2Y £ 300
		15X + 20Y £ 3000
		5X + 5Y £ 1000
B	Z = 4x + 8y	X + 2Y £ 320
		16X + 24Y £ 4000
		8X + 8Y £ 1600
C	Z = 5x +12y	X+2Y £ 360
		18X + 27Y £ 3600
		9X + 9Y £ 1800

All these data were plotted on a linear graph in order to get a feasible region and the optimum basic feasible solution which is in the final result of the research.

All the inequalities were first converted in equations and plotted on the graph. The shaded area PQRS was the feasible region and the point R, Q and R were the optimum basic feasible solution for branches A, B and C respectively. This is shown in the Figures 1, 2 and 3 respectively.

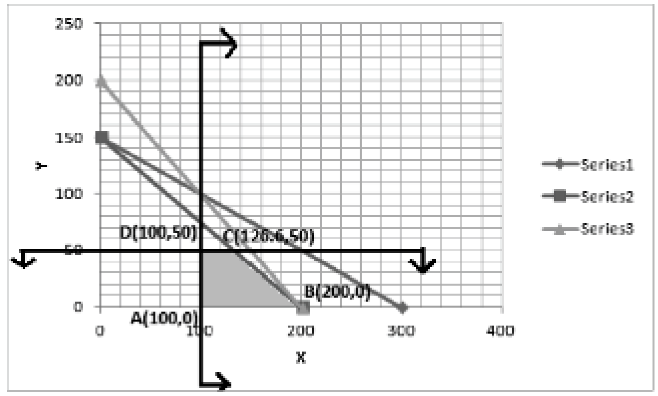

Fig. 1. Optimum feasible area of LPP for branch A

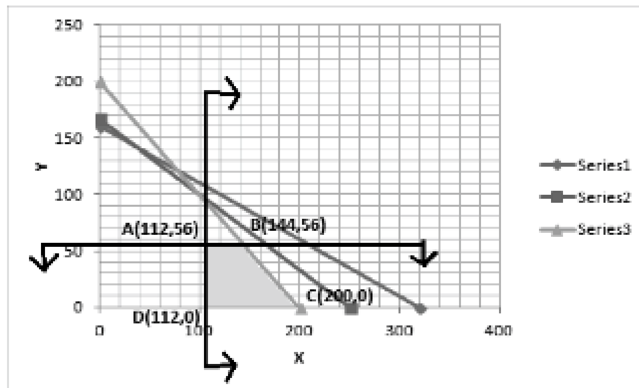

Fig. 2. Optimum feasible area of LPP for branch B

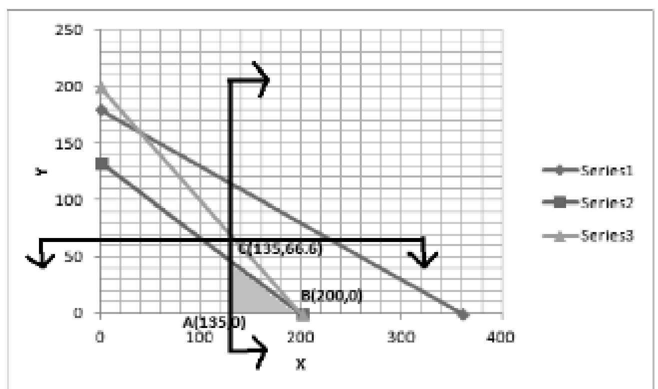

Fig. 3. Optimum feasible area of LPP for branch C

Following are the results of the study:

In branch A, if 127M notebooks and 50N notebooks were produced and marketed. The industry gained the profit of Rs. 1006.4.

In branch B, 144M notebooks and 56N notebooks were produced and marketed. The industry gained the profit of Rs. 1024.

In branch C, 135M notebooks and 67N notebooks were produced and marketed. The industry gained profit of Rs. 1474.2.

However, in practice the different rates of materials, machine hours and labor hours are not stable for longer period and this fluctuation in prices are proving a bottleneck for implementation of linear programming.

Conclusion:

In order to attain the maximum profit for branch A, the industry should produce 127 M and 50 N notebooks. Similarly, branch B and branch C should produce 144, 135 M notebooks and 56, 67 N notebooks respectively.

This trend was not followed by the industry in past. The industry was making production in just random manner. There was no significant proportion for the production of notebooks. So, to attain the maximum profit level and use their limited resources in the best possible ways the company should make productions according to the result of the research.

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References:

Chandrashekhar. S. (2016). *Operation Research Models and Methods.*

Darquennes Joreon (2017). Current issues in LPP Research and their impact on society. *Application in Applied Linguistics (AILA),* 26:11-23.

Modibbo U., Sam Son., Hafisu KR. (2015). Profit maximization in a production mix Company using linear programming approach to Resource allocation*. International journal of sciences: Basic and applied Research (IJSBAR).* 24:46-52.

Prasad Lalji (2014). Linear Programming. Paramount Publication. pp.34-37*.*

Swarup Kanti, Gupta P. K., Manmohan (2015). Operartion Research. Eighteenth Edition Sultan Chand and Sons. pp. 39-42, 65-68.