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Linear Programming Applications in Different Fields

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Abstract : Optimization is the way of life. We all have finite resources and time and we want to make the ultimate of them. From using our time productively to working force chain problems for any company – everything uses optimization. It's an especially interesting and applicable content in data wisdom. Linear programming (LP) is one of the simplest ways to perform optimization. It helps you break some truly complex optimization problems by making a numerous simplifying hypothetical. The thing of this paper is to submitting direct programming styles and the operations in Engineering Education through Scientific approach in the Curriculum. Quantitative styles help farmers plan and make opinions. An apt illustration of these styles is the direct programming (LP) model. These styles admit the significance of economizing on available resources among them being water force, labour, and conditions. This disquisition studies various LP operations including feed mix, crop pattern and rotation plan, irrigation water, and product transformation; that have the main part to enhance various angles of the husbandry sector. The paper will be a review that will probe into the operations of the LP model and it will also illuminate the various tools that are central to assaying LP model results.

Key words: Linear programming, productivity, optimum, plan, crops pattern, land allocation, optimization, scientific approach, Optimization problems.

1. Introduction:

Linear programming is a simple fashion where we depict complex connections through direct functions and also find the optimum points. The important word in the former judgment is depicted. The real connections might be much more complex but we can simplify them to direct connections. Operations of programming are everyplace around you. You use direct programming at particular and professional fronts. You're using direct programming when you're driving from home to work and want to take the shortest route. Or when you have a design delivery you make strategies to make your platoon work efficiently for on- time delivery.

Using direct programming requires defining variables, chancing constraints and chancing the objective function, or what needs to be maximized. In some cases, direct programming is rather used for minimization, or the lowest possible objective function value. Linear programming requires the creation of inequalities and also graphing those to break problems. While some direct programming can be done manually, relatively frequently the variables and computations come too complex and bear the use of computational software.

2. LINEAR PROGRAMMING:

Linear Programming Principally, the problem of LP refers to a fine program that has the objective functions and constraints of direct to minimize or maximize a problem in the field of optimization. LP problem can be stated as Max Z = CT X Subject to Layoff ı b X 0 Designing Multimedia Learning for Working Linear Programming where x is a decision variable, c and b are portions vector and A is a matrix. The simplex system is a system of splitting designed to break LP problems that have three or further variables, and agreement is performed by duplications with the same way until the optimum result is achieved. LP agreement with the simplex system is grounded on the idea of the graphical system, where the optimum result is always located at the corner point of the doable region. The summary of simplex algorithm is (1) lowest reduced cost, (2) test for optimality, (3) incoming variable, (4) test for unbounded, (5) gregarious variable, (6) pivot on a rs to determine a new introductory doable result set jr = s and return on step 1.

2.1 Example of a linear programming problem:

Let's say a FedEx delivery man has 6 packages to deliver in a day. The warehouse is located at point A. The 6 delivery destinations are given by U, V, W, X, Y, and Z. The numbers on the lines indicate the distance between the cities. To save on fuel and time the delivery person wants to take the shortest route.

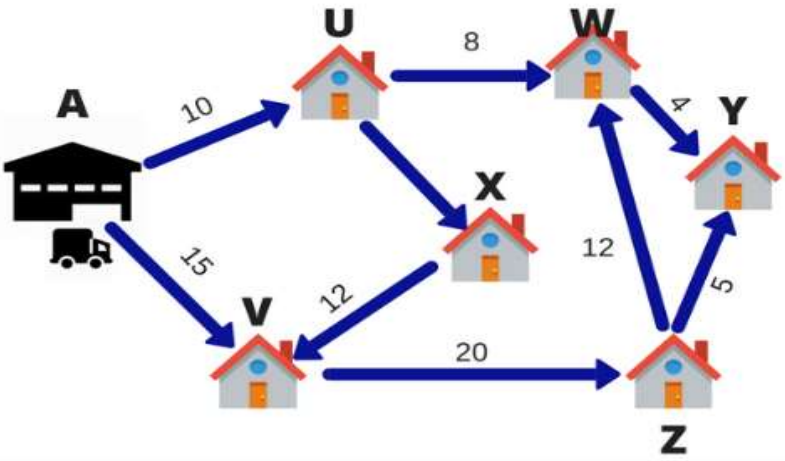

Fig-1

So, the delivery person will calculate different routes for going to all the 6 destinations and then come up with the shortest route. This technique of choosing the shortest route is called linear programming.

In this case, the objective of the delivery person is to deliver the parcel on time at all 6 destinations. The process of choosing the best route is called Operation Research. Operation research is an approach to decision-making, which involves a set of methods to operate a system.

3. *Agriculture and Food:*

Growers apply direct programming ways to their work. By determining what crops they should grow, the volume of it and how to use it efficiently, growers can increase their profit. In nutrition, direct programming provides an important tool to prop in planning for salutary requirements. In order to give healthy, low- cost food baskets for indigent families, nutritionists can use direct programming. Constraints may include salutary guidelines, nutrient guidance, artistic adequacy or some combination thereof. Mathematical modelling provides backing to calculate the foods demanded to give nutrition at low cost, in order to help no transmissible complaint. Undressed food data and prices are demanded for similar computations; all while esteeming the artistic aspects of the food types. The objective function is the total cost of the food handbasket. Linear programming also allows time variations for the frequency of making similar food baskets.

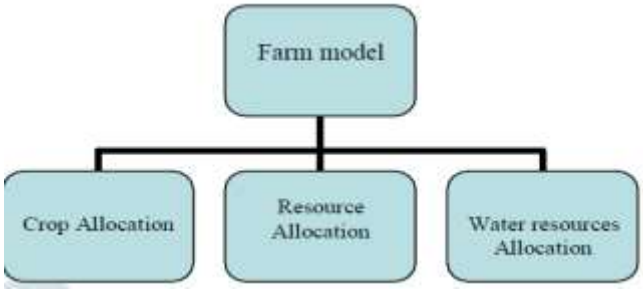

Fig-2

3.1 Solving Agricultural Problems by Applying Linear Programming:

In utmost husbandry planning problems, LP was used in different subjects, similar as allocation of limited coffers, including realty of the land, vacuity of the water and labour, granted capital, etc. that aims to maximize the net income. It evaluates the being coffers and also gives applicable results grounded on quantitative analysis. In general, there are a wide variety of operations of LP in husbandry. Figure 3 illustrates utmost of the use of direct programming in husbandry. The following subsections describe the operations of LP in detail.

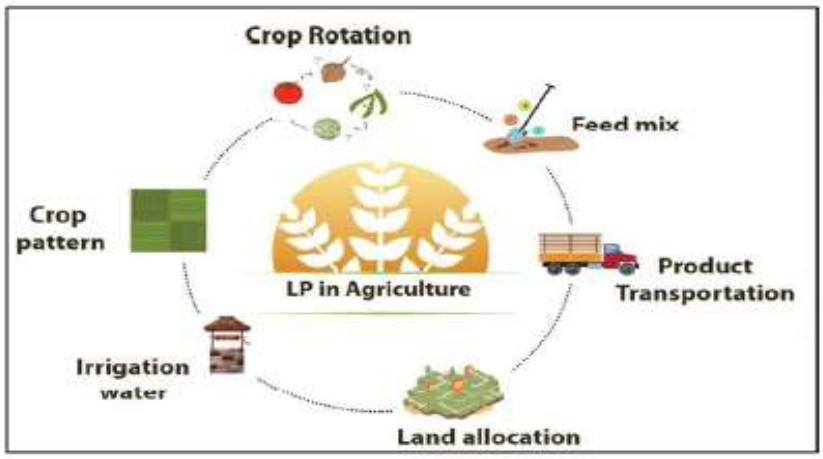

Fig-3

3.2 STUDY AREA:

Eluru municipality is located at 16 ° 42'38.38"N to 81 ° 5'42.88"E. Total geographical region of the state is 16297500 ha. Utmost of the people are engaged in primary sector especially those that resides in pastoral regions. Net sown area of the quarter is about 393320 ha and gross sown area is about 655936 ha. Major Kharif crops of the region includes Sugarcane, Paddy and the crops cultivated in Rabi season are Maize, Tobacco, Groundnut, Beats and Sunflower.

Mango, Coconut, Oil win, Cashew, Citrus, Banana, Turmeric, Sapota, Papaya, Cucumber,Gourds,Bhendi, Brinjal, Tomato, Cabbage, Cauliflower and Leafy vegetables which are treated as other important Horticulture Crops grown in the quarter.
Eluru exploits hot and sticky climate due to its contiguity to the underpinning of Bay of Bengal. It has an average periodic temperature of28.2 °C. May is the hottest and December is the coolest month of the time. Temperature crosses 40 °C in summer. July receives most rush and annually the municipality receives an average downfall of 992 mm.

Name of the Crop	Area (ha)	Production (ton)	Productivity (kg/ha)
Paddy	1587136	8639077	5443
Jowar	4526	5491	1213
Bajra	28108	64078	2280
Maize	113713	528121	4644
Ragi	24689	32046	1298
Korra	11039	14205	1287
Red gram	220332	114435	519
Green gram	10208	6391	626
Black gram	29513	25610	868
Horse gram	2336	1422	609
Groundnut	743702	772568	1039
Sesamum	7149	2466	345
Sunflower	1784	2216	1242
Soyabean	1607	3126	1946
Cotton	601455	1151184	1914
Sugarcane	46552	3634966	78084

Table-1: Area, production and productivity of major crops cultivated in Eluru

A Linear programming problem with "n "decision variables and "m "constraints is formulated as:
Max.Z=Σ cixi i=1,2, 3,.. n
s.t. Σ ai xi ≤ Σ bj j=1,2, 3, …..m xi ≥ 0
xi= represents the decision variables (to be determined by policy makers)
ci= represents the cost vector
ai= represents activity coefficient
bj= represents the available resources.

The objective function is:

Max Z= $5443X_1+1039X_2+1242X_3+1914X_4$ Subject to the constraints $1587136X_1+743702X_2+1784X_3+601455X_4 \leq 393320$

Seeds& fertilizers $X_1 + X_2 + X_3 + X_4 \leq 100000$

$X_1 + X_2 + X_3 + X_4 \leq 200450$

Non negative constraints $X_1 + X_2 + X_3 + X_4 \geq 0$

$X_1, X_{2,} X_{3,} X_4$, are decision variables for paddy, ground nut, sunflower and cotton respectively.

Result:

Result of the developed linear programming farm model is obtained by using simplex method. Result of the problem shows that farmer can get a profit of 273824.79 Rs. The solution of the problem yields the following results:x_1= 0, x_2=0, x_3= 221.471 and x_4=0

The objective of the study is to maximize the farm returns by allocating the resources optimally. Only the crops grown in Rabi and kharifseason i.e., paddy, ground nuts, sunflower and cottonare considered for the study. The problem is to determine the suitable crop combination in order to get maximum profit. The land available for cultivation is 393320 hectares. Proper allocation of crops and the available resources is very important in order to increase the productivity and also for the efficient utilization of resources as west Godavari district of Andhra Pradesh. Therefore, the variation in cropping pattern is observed within district depending upon the availability of water resources. Farms with sufficient water prefer to cultivate paddy and ground nuts more whereas the farms with less availability of water grow sunflower and cotton as a major crop. Moreover, in order to increase the production farmers adopt different farming patters such as crop rotation, inter cropping and mixed cropping. It is observed that there is increase in production to about 25% by adopting theses crop policies Farmers especially the small farmers prefer to adopt mixed cropping that includes both livestock as well as cultivation of crops within the same farm. Livestock rearing contributes to increases the farm returns to great extent.

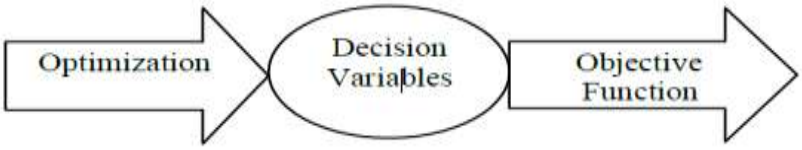

Fig-4

4. Application oriented multimedia:

At the morning of the history of education, preceptors are only one as a medium of literacy. In the ultramodern period, the preceptors have realized that everything can be used as a medium of literacy, including the academy terrain and at the end, video like computer. Learning media is commodity that can be used to deliver a communication from the sender to the receiver so that the literacy process will do. Media are physical means which are used to shoot dispatches to the scholars and stimulate them to learn.
Learning Media is a combination of tackle and software. There are several types of media that's media plates, audio and multimedia. Graphic media is a media using visual symbols, similar as sketches, graphs, flow maps or other. Audio media is a medium that's associated with the sense of hail. Multimedia can be defined as an interactive communication system and combination from the data drivers, similar as the internet and software. Multimedia is a media associated with the use of technology like computers and software. The profitable of multimedia in tutoring is to increase scholars' learning gests make time effectiveness, produce a conducive literacy terrain laboriously share in the literacy process and ameliorate scholars' enthusiasm and performance.

A lot of multimedia can be used in working the LP, where algorithm simplex system has been applied in some software, analogous as LINDO and LINGO package. LINDO is a accessible, but important tool for working direct, integer, and quadratic programming problems. LINGO is a comprehensive tool designed to make structure and working direct programming problems. Fresh Software for working LP like Excel program still needs to set the algorithm on a worksheet. Therefore, using the Excel program allows scholars to introduce, be creative and increase scholars' interest to break further LP.

The result for LPP model:

The solving of LP, the simplex method and multimedia with the Excel program, LINDO and LINGO package will be shown the stages and the results are based on a model LP stated as follows. Max Z = 3X1 + 6X2 + 4X3
Subject to:
3X1 + 4X2 + X3 ≤ 60
2X1 + 3X2 + X3 ≤ 50
X1 + 2X2 + 2X3 ≤ 44
Where X1, X2, X3 ≥ 0
In Simplex Method the summary stages of LP solving with the simplex method is described as follows.
Standard form Max
Z = 3X1 + 6X2 + 4X3 + 0S1 + 0S2 + 0S3
Subject to:
3X1 + 4X2 + X3 + S1 = 60
2X1 + 3X2 + X3 + S2 = 50
X1 + 2X2 + 2X3 + S3 = 44
Where X1, X2, X3 ≥ 0
In its second stage will determining the initial table simplex proceed to the next stage, iterating with steps of testing and calculations respectively as the following: smallest reduced cost Hardi Tambunan test for optimality, incoming variable, test for unbounded, * outgoing variable, pivot on a¯rs to determine a new basic feasible solution set jr = s and return on first step. The iteration process is done to obtain the maximum value of the objective function. Results of the solving can be summarized in the tables.

Table 1: Results

	Cj	3	6	4	0	0	0		
CB	VB	X1	X2	X3	S1	S2	S3	LHS	RHS
0	S1	3	4	1	1	0	0	60	15
0	S2	2	3	1	0	1	0	50	(16,67)
0	S3	1	2	2	0	0	1	44	22
Zj		0	0	0	0	0	0		
Zj - Cj		-3	-6	-4	0	0	0		

Table 2: Results

	Cj	3	6	4	0	0	0		
CB	VB	X1	X2	X3	S1	S2	S3	LHS	RHS
6	X2	3/4	1	1/4	1/4	0	0	15	60
0	S2	-1/4	0	1/4	-3/4	1	0	5	20
0	S3	-2/4	0	6/4	-2/4	0	1	14	9.33
Zj		(4,5)	6	(1,5)	(1,5)	0	0		
Zj - Cj		(1,5)	0	-2,5	-1,5	0	0		

Table 3: Results

	Cj	3	6	4	0	0	0		
CB	VB	X1	X2	X3	S1	S2	S3	LHS	RHS
6	X2	2/3	1	0	5/6	0	-4/24	12,67	-
0	S2	-1/6	0	0	- 2/3	1	-1-6	2,67	-
4	X3	-8/24	0	1	-8/24	0	4/6	9,33	-
Zj		5,33	6	4	0,33	0	1,67	113,33	
Zj - Cj		2,33	0	0	0,33	0	1,67		

The results of solving LP with simplex method, the value of the maximum, Z = 113.33 at X_1 = 0, X_2 = 12.67 and X_3 = 9.33.

4.1 MAJOR LPP APPLICATIONS IN ENGINEERING:

In nutrition, direct programming provides a important tool to prop in planning for salutary requirements. In order to give healthy, low – cost food baskets for indigent families, nutritionists can use direct programming. Constraints may include salutary guidelines, nutrient guidance, artistic adequacy or some combination, Mathematical modelling provides backing to calculate the foods need to give nutrition at low cost in order to help non-communicable complaint.
Linear programming also allows time variations for the frequency of making similar food baskets. Masterminds also use direct programming to help break design and manufacturing problems. For illustration, in air antipode morass, masterminds seek aerodynamic shape optimization. This allows for the reduction of the drag measure of the air foil. Constraints may include lift measure, relative outside consistence, nose compass and running edge angle. Shape optimization seeks to make a shock-free air foil with a doable shape. Linear programming, thus, provides masterminds with an essential tool in shape optimization. Operation Research has contributed significantly to erecting engineering through fine modelling of ill- defined problems such a resource allocation and scheduling. While fine models are useful; their operation is hindered by the
non-availability of precise data and complexity in the expression of objective functions and constraints that meaningfully reflect real- life situations. This may beget difficulties in representing these interacting variables for optimization. To

overcome these difficulties, LPP methodology introduced the rearmost fashion in operation exploration to represent the variations using a fuzzy sense approach.
This embedding approach will eventually acknowledge and postulate that objective function and constrains are for the same nature and that the distinction between them is gradual rather than abrupt. One application of this integrated approach to a case study demonstrates the qualitative factors in a more meaningful way than classical linear programming.

4.1.1 TRANSPORTATION OPTIMIZATION:

Transportation systems Calculate upon direct programming for cost and time effectiveness. Machine and train routes must factor in scheduling, trip time and passengers. Airlines use direct programming to optimize their gains according to different seat prices and client demand Airlines also use direct programming for airman scheduling and routes. Optimization via direct programming increases airlines effectiveness and decreases charges.

4.1.2 EFFICIENT MANUFACTURING:

Manufacturing requires transubstantiating raw accoutrements into products that maximize company profit. Each step of the manufacturing process must work efficiently to reach that thing. For illustration, raw accoutrements must past through colourful machines for set quantities of time in an assembly line. To maximize profit, a company can use a direct expression of how important raw material to use. Constraints include the time spent on each machine. Any machines creating backups must be addressed. The number of products made may be affected, in order to maximize profit grounded on the raw accoutrements and the time demanded.

4.1.3 ENERGY INDUSTRY:

Ultramodern energy grid systems incorporate not only traditional electrical systems but also renewable similar as wind and solar photovoltaic. In order to optimize the electric cargo conditions, creators, transmission and distribution lines, and storehouse must be taken into account. At the same time, costs must remain sustainable for gains. Linear programming provides a system to optimize the electric power system design. It allows for matching the electric cargo in the shortest total distance between the generation of the electricity and its demand over time. Linear programming can be used to optimize cargo-matching or to optimize cost, furnishing a precious tool to the energy assiduity.

5. CONCLUSION:

From the qualitative data, it is apparent that the linear programming model is prevalent in operations research. LP solved problems have one goal that aims to maximize or minimize a specific goal, usually costs, revenues, or net income. Linear programming optimization problems for finding a maximal or minimal value of function within a set of constraints. Several researchers found that LP with a Simplex method helps to get an optimum land allocation plan. They found that it improved farm productivity and increased the profit when the total allocated area was increased. The use of multimedia learning is very necessary for mathematics learning, including learning linear programming (LP) in mathematics education. Many multimedia software can be used to facilitate solving LP, such as LINDO, LINGO.

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