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Achieving and Maximizing Profits in L. Idris Holding using Linear Programing Model

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ABSTRACT

Linear programming, an operation of simplex method technique is widely use in finding solutions to complex and difficult problems in several fields of studies and enterprises using various methods. There is always a need to properly manage scarce resources to either maximize profit or minimize cost. This study was carried out to arrive at an optimal solution in L. Idris Holdings in the production of various sizes of blocks (9 inches open, 6 inches open, 6 inches blind, 5 inches blind, 4 inches blind and interlocking blocks). The analyses and result shows from the model indicates that the 6 inches' block should be produced more (100) in order to maximize more profit of #800 profit. Hence, 6 inches of blocks should be produced more.

Keywords: Linear Programing, L. Idris Holding, Profits.

Introduction

Business have constantly being faced with a need for optimal decision making. The survival of any business is based on the right or wrong decision taken by its management from time to time. There is always a need to properly manage scarce resources to either maximize profit or minimize cost. The problem has always been which combination of resources, management will approve to yield optimal profit. Linear programming is used in the area of planning, production, transportation, technology and military hardware deployment. Balogun et.al (2013). Linear programming is a family of mathematical science that is concerned with the allocation of scare or limited resource through determining the best outcome such as maximizing profits or minimum cost in a given mathematical model. Limitation or restriction is seen as a common problem in any business anywhere in the world and the lack of preventive measures to handle these can cause negative consequence. Thus the technique of linear programing is used in various part of human endeavor such as agriculture, industry, transportation, economics, health system and the military.

However, many firm in Nigeria are faced with problems on how to utilizes the available resources to maximize in order to maximize profit due to the use of trial and error method, which will eventually lead to the reduction in the accuracy of forecasting for the future of some market determinant such as price flotation and the availability of raw materials. The block production business which has been increasing steadily in Nigeria is among the largest earners and employer of labor due to the emphasis placed on it by the government, corporate individuals and persons alike. It comprises of large, medium, small scale manufacturers, small cottage and house hold type who produced different type of blocks depending on the demands. Thus this study was done using linear programming to provide optimal solution for production output under normal production environment in L. Idris and prove that the application of the technique in determining the profit maximization in the block will be more profitable thus given inference on how to allocate resources to ensure optimal profit.

Literature Review

Under this research, we shall have reviewed different literature, Swati Kashyap (2017) argues that linear programming can be used for obtaining the most optimal solution for a problem with given constraints. He said in linear programming real life problems are formulated into a mathematical model. Stapel, Elizabeth (2019) Linear programming introduction "Purple Math define linear programming as a process of taking various linear inequalities relating some situation and finding the best value obtaining under those conditions, given as example of taking the limitation of materials and labour and then determining the "best" production levels for maximizing profit under those condition. Paulray, C. Chellappan & G.R. Natesan (2006) "A heuristic approach for identification of redundant constraints in linear programming models, sees linear programming as one of the most important techniques used in modeling and solving practical optimization problems that arise in industries. He also observed that where formulating can be model, systems analyst and researches, often include all possible constraints, though some of them may not be binding at the optimal solution. The presence of redundant constraints does not alter the optimum solutions. In this study, they propose a heuristic approach using an intercept metrics to identify redundant constraints prior to the start of the solution process and tendency of variables to pop in and pop out of the basis is eradicated often eliminating the redundancies.

Marion G. Molins (2018) in Product Mix optimization at minimum supply cost of an online clothing store using linear programming. This study focused on line clothing store with data provided by an online clothing store owners were used to estimate the parameters of the linear programming model. The LP method was solved using QN for software to determine the most economical product mix to the purchased by the online clothing store owners firm than suppliers and then provide an optimums solution. It was recommended that the owners should continue using linear programming in determining the number of each product to be purchase and also to determine the optimal product mix for maximum profit. Balogun O.S. Role et al. (2013) Application of linear programming in a manufacturing company in feed masters, Kulende, Kwara State. This research was based on using linear programming technique to derive the maximum profit from production of feeds produced by feed, Masters Limited, Ilorin, Kwara State. Linear programming of the operatives was formulated and optimum results derived using software that employ simplex method. Based on the data collected, the optimum result indicate that three products should be produced 25kg of layer mesh. 25kg of linear mesh and 25kg of Broiler finishes mash thug production quantities should be 182,1000 and 1000 units respective will produce a maximum profit of N668,367.

Yasser M.R. Aboelmagd (2018), linear programming applications in construction sites. This papers focused on a linear programming techniques to spotlight decision making application for optimizing competitive bidding strategy to select best tender various linear programming models were formulated to solve various cost and time problems by using LINDO software. The main conclusions drawn for the study are taking advantages of the potential possibilities of a linear programming model to support decision-making processes, evaluate some tasks, which includes Determination and Evaluation the bids which appropriate the company’s resources, determination and evaluation of the optimal time and the optimal cost for implementation construction projects.

Akpan N. P & Iwo I. A. (2016) in their researched Application of LP for Optional Use of Raw Materials in Bakery. This work utilized the concept of Simplex Algorithm which are aspect of linear programming to allocate raw materials to competing variables big loaf, grant loaf and small loaf) in bakery for the purpose of profit maximization. The analysis was carried out as the result showed that 96ɖ unit of small loaf, 38 units of big loaf and ɖ unit of grant loaf should be produced respectively in order to make a profit of N20385. From the analysis it was observed that small loaf, followed by big loaf contribute objectively to the profit, hence recommended that small loaf and big loaf are needed in order to maximize profits. NK Oladejo, el at (2019) Optimization principle and its application in optimizing Land Mark University Bakery Production using linear programming. The researched studies the applications of optimization principle in optimizing profits of a production industry using linear programming to examine the production cost and determines its optimal profit. Also the studied used of secondary data collected for the record of the Landmark University bakery on five types of bread produced which includes family loaf, sliced family bread, chocolate loaf, medium size bread, small size bread. A linear programming problem was identified, formulated in mathematical terms and solved using AMPL Software. The solution obtained revealed that Landmark bakery unit should concentrate more in production of 14,000 loaves of family loaf and chocolate bread contributed objectively to the profit.

Raimi Oluwole et al (2017). Application of linear programming technique on Bread Production optimization in Rutions Guinea Prologredum Bakery (2017). This paper examines the optimization of bread production in Rufus Giwa Polytechnic Bakery, Owo Oyo State using linear programming technique and three types of bread were considered; Medium bread (X), Large bread (X_2) and extra large (X_3) respectively. The data was analyzed using LINGO software various 5. Thus the recommendation basis on the findings reveal that the focus more on the production of extra-large bread to make a maximum profit of ₦47572 the unit profit on the medium bread and large bread must be increase to ₦39474 and ₦27450. The study of Linear optimization techniques for product mix of paints production in Nigeria was undertaking Sulaiman Olanrewaju et al. This research focuses on linear optimization for achieving product-mix optimization in terms of the product identification and the right quantity in pant production for better profit and optimum firm performance. In data analysis, linear program model was employed with the aid LINGO II Software to analysis the data and it shows that only two out of the five product under consideration are profitable.

Optimizing profit in Lau Baking Industry Latra with linear programming model by Totilayo Dorcas et al (2018), The study was carried out to seek and at the optimal solution in Lace Bakery, Lafia. Data was collected on six types of drugs package which include family loaf, 4kg), Fancy bread (1kg) mini loaf (150g), Banana Bread (800g) coconut bread (900g), fruit bread (1kg). The solution obtained by using the R statistical software reveal feet – 1550 loaves of family loaf and 4650 loaves of mini loaf should be produced respectively while others should be ignored in order to maximize monetary profit of ₦558000.Linear programming for Aggregate Production Planning in a textile company Emi Antinio Campo, et al (2018).Strategies in the medium term for a textile company, for which a linear programming models "proposed to minimize total costs associated with labor and inventory levels. This model is implemented and solved in GAMS, supported on an MS Excel interfaces, to find the optimal solution, which is to apply a hybral strategy to the production plan. Aggregate planning for minimizing cost: A Case study of PT XYZ in Indonesia BNT, Simamora, D. (2014) to calculate the seasonal forecasted demand and develop aggregate production planning for PT X YZ to meet seasonal demand with lowest cost. The data was from secondary data strictly for the past 3 years and was used to forecast the seasonal demand using multiplicative seasonal model. The result of this study show that the mixed strategy in the optimal strategy to meet demand with the lowest cost for Pt X YZ.

S. Rodrigo Del Solac el at (2004) Aggregated production plan in Saw Wood Mill Case of Study for small industry. This study case presented corresponds to the type of these industries, producer of saw wood radiate pine, in which an aggregate production. It was evaluated from products strategies related to the labor force, the inventory level production and demand. The result lead to a conclusion that it is possible to reduce the cost production, assuring political labor add approprialling inventory level, with the cost diminished in 1929, swing the company more than 6 million chilern per annual.

Thomas Sillekins el at (2018) Aggregate production planning in the automotive industry with special consideration of workforce flexibility. The study presents a new mixed integer linear programming approach for the producers of aggregate production planning of flow shop adaptations, which originates from technical characteristics of assembly linear as well as from work regulations and shift planning, taking into account and explicitly represent a working time account via a linear approximation. Finally, the research presents are illustrative case study and computational results on problem instances of practically relevant complexity. W. Crok, & Dash (2007) Exact Solutions to linear programming problems DL Applegate, use the floating point calculation limits, the accuracy of solutions obtained by standard LP software. Also presented a simpler-based algorithm that returns exact rational solutions taking advantage of the speed of floating point calculus attempted to minimize the operations performed in rational arithmetic.

Sargeaun T.M. 1965 "Operation Research – An Introduction; wrote that the principal types of application of LPP models are categorized under three headings namely, blending and mix determination problems, planning and scheduling problems and distribution cost problems. He also notes other types of applications such as plant location, decisions, personnel allocation problems and the analysis of a multi plants production systems determine whether or not certain plants should be shut down as a result of high cost of production. Ezema B.I. and Amo Kom, U. (2012) optimizing profit with the linear programming model; A focus on Golden Plastic Industry Limited, Enugu, Nigeria.. The study was carried out to seek and arrive at the optimal product-mix of a productive firm – the golden plastic industry limited. The result shows that only two sizes of the total eight "PVC" pipes should be produced and produce 114,317.2pieces of 25mm by 5.4m conduit pipes and 7,136.564 pieces of 20mm by 5.4m thick pressure pipes and zero quantities of the rest sizes of pressures pipes per month in order to obtain a maximum profit of ₦1,964,537.

Veselovska, L, (2014): A linear programming model of integrating flexible measures of into production process with cost minimization presented a linear programming model developed in order to achieve flexibility in operation management and also to minimize cost throughout the whole production processes. The linear programming model of production is quite general in its nature and makes it possible to apply it on any production cost.

Therefore, in this study I adapted a mathematical model that provides optimal solution for production output under operational environment. I highlighted the peculiarity of using the linear programing techniques and prove the application of the technique in determining the profit maximization in the enterprises.

Algorithm for Solving Programming Problem (Balogun Et.al, 2013)

i See that all $b_i s'$ are positive, if a constraint has negative b_i multiply it by -1 to make b_i positive.

ii Convert all the inequalities by the addition of slack or by subtraction of surplus variable as the case may be.

iii Find the starting Basic Feasible Solution.
iv Construct the Simplex table as follows:
v Testing for optimality of Basic Feasible Solution by computing . $\Delta Z_j - E_j$ if $Z_j - E \geq 0$, the solution is optimal; otherwise, we proceed to the next step.
vi To improve on the Basic Feasible Solution, we find the basic matrix. The variable that corresponds to the most negative of $Z_j - E_j$ is the INCOMING VECTOR while the variable that corresponds to the minimum ratio bi/aj_i for a particular j and aij , $a_i \geq 0$, I = 0, 1,2,3,...m is the OUTGOING VECTOR.
vii The key element or the pivot element is determined by considering the intersection between the arrows that corresponds to both incoming and outgoing vectors. The key element is used to generate the next table. In the next table, pivot element is replaced by UNITY, while all other elements of the pivot column are replaced by zero. To calculate the new values for all other elements in the remaining rows of that first column, we use the relation.
viii New row = Former element in old rows – (intersection element in the old row) × (Corresponding element of replacing row). ( ) viii Test of this new Basic Feasible Solution for optimality as (6) it is not optimal; repeat the process till optimal solution is obtained.

Methodology and Data Analysis

The general linear programming model with n decision variables and m constraint can be stated as follows

Optimize (max or min)

$Z=C_1X_1 + C_2X_2 + \ldots\ldots\ldots\ldots\ldots. +C_n X_n$

Such that

$a_{11}x_1 + a_{12}x_2 + \ldots\ldots\ldots\ldots\ldots\ldots. a_1nxn \ (\leq,=,\geq)\ b_1$

$a_{12}x_1 + a_{22}x_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots a_2nxn \ (\leq,=,\geq)\ b_2$

. .

. .

. .

$a_{m1}x_1 + am_2x_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots a_{mn}\, x_n\ (\leq,=,\geq)\ b_m$

Which also can be expressed as

Max or Min $Z=\sum Ci\ Xi$ …………….

Subject to the linear constraint

$Z= \quad \sum aij\ Xi \qquad (\leq,=,\geq)\ bi,\ i=1,2,3 \ldots\ldots\ldots\ldots\ldots. n$

$Xj\geq 0\ j=1,2,3\ldots\ldots\ldots\ldots. n$

Where

1. X_1, X_2………… Xn are the decision variables to be maximize. They represent the different type of block.

2. $C_1, C_2, C_3 \ldots\ldots\ldots. C_n$ are the unit profit of the different types of block production.
3. Z is the objective functions to be maximized. The maximization of Z is carried out so that the m constraint is Standard form of a linear programing model

The use of simplex method to solve a linear programming problems requires that the problems be converted into its standard form with the following properties:

i) All the constraint should be expressed as equation by adding a slack variable
ii) The right hand side of each constraint should be made up of non-negative, if not this is done by multiplying both sides of the resulting constraint
iii) The objective form should be of maximization type.

The n decision variables and m constraint, the standard form of the linear programming model can be formulated as follows

Optimize

$$Z = C_1x_1 + C_2X_2 + \ldots\ldots\ldots C_n X_n + 0s_1 + 0s_2 + \ldots\ldots\ldots + 0_{Sm}$$

Subject to the linear constraint

$$a_{11}x_1 + a_{12}x_2 + \ldots\ldots\ldots + a_{1n}x_n = b$$
$$a_{12}x_1 + a_{22}x_2 + \ldots\ldots\ldots + a_{2n}x_n = b$$
$$. \qquad\qquad\qquad .$$
$$a_{m1}x_1 + a_{m2}x_2 + \ldots\ldots\ldots a_{mn} x_n = b$$

Data Presentation

The data was collected from L. Idris Holdings Port Harcourt. The data consist of the total amount of raw materials (Sand, Cement, Water and including the amount paid to the laborers for each types of block produced) available for the production of six different types of block produces in the company which include 9 inches (open),6 inches (open),6 inches (blind),5 inches (blind),4 inches (blind) and interlocking block.

Sand

Total amount of sand available = 100kg
Each unit of 9 inches' block (open) requires 6kg of sand
Each unit of 6 inches block requires (open) 5kg of sand
Each unit of 6 inches block (blind) requires 8kg of sand
Each unit of 5 inches block (blind) requires 6kg of sand.
Each unit of 4 inches (blind) block requires 6kg of sand
Each unit of interlocking block requires 1kg of sand

Cement

Total amount of sand available = 50kg
Each unit of 9 inches' block (open) requires 2kg of cement.
Each unit of 6 inches block requires (open) 1kg of cement.

Each unit of 6 inches block (blind) requires 4kg of cement.
Each unit of 5 inches block (blind) requires 3kg of cement.
Each unit of 4 inches (blind) block requires 2kg of cement.
Each unit of interlocking block requires 1.9kg of cement.

Water
Total litres of water available = 300
Each unit of 9 inches’ block (open) requires 3 litres of water
Each unit of 6 inches’ block (open) requires 2.4 litre of water
Each unit of 6 inches’ block (blind) requires 5 litres of water
Each unit of 5 inches’ block (blind) requires 4 litres of water.
Each unit of 4 inches (blind) block requires 3 litres of water
Each unit of interlocking block requires 2 litres of water

Labour
Total amount of to pay laborers = #500
Each unit of 9 inches’ block (open) requires #30
Each unit of 6 inches’ block (open) requires #25
Each unit of 6 inches’ block (blind) requires #40
Each unit of 5 inches’ block (blind) requires #35
Each unit of 4 inches block (blind) requires #30
Each unit of interlocking block requires #10

Profit per unit product of block produced

Names of Product	**Production cost per block (#)**	**Selling Price per block (#)**	**Profit (#)**
9 inches’ block (open)	110	150	40
6 inches’ block (open)	70	120	50
6 inches’ block (blind)	100	200	100
5 inches’ block (blind)	80	130	50
4 inches block (blind)	80	120	40
Interlocking block	35	50	15

Types of the block and their material

Names of Product	Sand	Cement	Water	Labour
Quantity Available	100	50	300	500
9 inches' block (open)	6	2	3	30
6 inches' block (open)	5	1	2.4	25
6 inches' block (blind)	8	4	5	40
5 inches' block (blind)	6	3	4	35
4 inches block (blind)	5	2	3.0	30
Interlocking block	1	1.8	2	10

Subject to
$6X_1 + 5X_2 + 8X_3 + 6X_4 + 5X_5 + X_6 + S_1 \leq 100$
$2X_1 + X_2 + 4X_3 + 3X_4 + 2X_5 + 1.8X_6 + S_2 \leq 50$
$3X_1 + 2.4X_2 + 5X_3 + 4X_4 + 3X_5 + 2X_6 + S_3 \leq 40$
$40X_1 + 30X_2 + 50X_3 + 40X_4 + 35X_5 + 15X_6 + S_4 \leq 500$

Adding some slack variables it now becomes
$Z = 40x_1 + 50x_2 + 100x_3 + 50x_4 + 40x_5 + 15x_6 + 0S_1 + 0S_2 + 0S_3 + 0S_4 + 0S_5 + 0S_6$

Subject to
$6X_1 + 5X_2 + 8X_3 + 6X_4 + 5X_5 + X_6 + S_{1=} 100$
$2X_1 + X_2 + 4X_3 + 3X_4 + 2X_5 + 1.8X_6 + S_2 = 50$
$3X_1 + 2.4X_2 + 5X_3 + 4X_4 + 3X_5 + 2X_6 + S_3 = 40$
$40X_1 + 30X_2 + 50X_3 + 40X_4 + 35X_5 + 15X_6 + S_4 = 500$

Where Z is the profit function that we seek to maximize.

	CJ	40	50	100	50	40	15	0	0	0	0	
	B.V	X_1	X_2	X_3	X_4	X_5	X_6	S_1	S_2	S_3	S_4	Sol
0	S_1	6	5	8	6	5	1	1	0	0	0	100
0	S_2	2	1	4	3	2	1.8	0	1	0	0	50
0	S_3	3	2.4	5	4	3	2	0	0	1	0	40
0	S_4	30	25	40	35	30	10	0	0	0	1	500

Zj = 0 0 0 0 0 0 0 0 0 0

Cj-Zj = 40 50 100 50 40 15 0 0 0 0 0

For max all Cj - Zj ≤ 0
For min all Cj - Zj ≥ 0

Where X3 becomes the key row and S_3 becomes the key column and 5 the key element
After the first iteration,

	CJ	40	50	100	50	40	15	0	0	0	0	
	B.V	X_1	X_2	X_3	X_4	X_5	X_6	S_1	S_2	S_3	S_4	Sol
100	X_3	3/5	½	1	4/5	3/5	2/5	0	0	1/5	0	8
0	S_1	6/5	6/5	0	-2/5	1/5	-9/5	1/5	0	0	0	-39/5
0	S_2	-2/5	-9/5	1	-1/5	-2/5	2/5	0	1/5	0	0	-39/5
0	S_4	6	10	1	3	6	6	0	0	0	1/5	180

Zj = 60 50 100 80 60 40 0 0 20 0 800
Cj- Zj = -20 0 0 -30 -20 -25 0 0 0 0 -20 0

The above linear programming model was solved manually which gives an optimal solution of X3=100, Zj=800(in thousand)

Interpretation of Results

Based on the data collected the optimum result derived from the model indicates that the 6 inches' block should be produced more (100) in order to maximize more profit of #800 profit.

Summary and Conclusion

The objective of this study is to apply linear programming for the optimal use of raw material in block production due to the scarcity of materials use in the construction industry. The decision variables in the study is the various sizes and makes of blocks produced by L. Idris (9 inches open,6 inches open,6 inches blind,5 inches blind,4 inches blind and interlocking blocks). The researcher focused on only the three raw materials used by L. Idris in their block production, including the labour charges since labourers are employed and paid on daily basis. The result shows that 100 unit of block will give a maximum profit of #800000.

Based on the analysis carried out, L. Idris should produce the other five types of block (9 inches open,6 inches open,6 inches blind,5 inches blind,4 inches blind and interlocking blocks)) in other to satisfies their customers but more of the 6 inches blind block should be produced to maximize more profits.

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