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APPLICATION OF AND COMPUTING FEASIBLE UNIQUE SOLUTIONS OF LINEAR PROGRAMMING DETERMINISTICALLY; MATLAB ALGORITHMS

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ABSTRACT

This study invested on the application of and computing feasible unique solutions of linear programming deterministically. Algebraic analytical calculations and matlab algorithms model were applied in computing the results. The choice of matlab algorithms was made because it is uniquely designed for matrix computations especially in

INTRODUCTION:

Universally, life is spiced with challenges (problems). And how to overcome these life challenges arose in many fields of life which linear programming is one of them. Linear programming model is a straight line relationship between the decision making variables in a mathematical modelling and finding solutions to problems that comprises use of limit resources, by taking decisions from any given outlined strategies in order to accomplish the desired objectives. Linear Programming model is used for resource allocation when the resources are limited and there are number of competing candidates for the use of the resources. The model is used for maximizing the returns or minimizing the cost. Murthy (2007), viewed Linear Programming as one of the most versatile, powerful, and useful techniques for making managerial decisions. A feasible unique solution of linear programming is the point where the isoprofit or isocost line coincides with one of the feasible region. A Feasible region is a set of points (x_1, x_2) which satisfies all the constraints, (Michael 1997).

Linear is the existence of a straightline relationship among variables in a model. This means that a given change in one variable leads to a proportional change in another variable. Example, increasing the investment on a particular project will equally lead to increase in rate of production. Programming is all about the mathematical modelling and solving of a problem that involves the use of limited resources, by choosing a particular course of strategy among the given courses strategies in order to achieve the desired objective. According to Euler, L. (1783), nothing happens in the universe that does not have a sense of either certain maximum or minimum. Michael C. F., Olvi, L. M., and Stephen, J. W. (2007) in their work explained that optimization is a fundamental tool for understanding nature, science, engineering, economics, and mathematics, physics and chemical systems.

The aim of this study is to discover the best corner point out of the numerous feasible solutions of a linear programming model that will produce the best output as to maximize a desired

solving systems of linear equations and its ability to create concise codes. The objective of the study is to identify the feasible unique solutions of linear programming that corresponds with the initial state and input. The study reveal that the best feasibly solutions of linear programming occurs at the point where the two decision variables have positive values. Hence, several feasible corner points that maximize the objective function were discovered. The best corner point that produces the best objective function that is corresponding to the specified value of the constraint value of 18 is identified at 105% variation with feasible point (15.45, 0.69) and the objective function value of 33.66.

Keywords: *Optimization, Linear Programming, Feasibility, Matlab Algorithms, Deterministic.*

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objective function using Matlab algorithms. To achieve this, the general structure of Linear programming model was considered as:

1. In linear programming model, all the decision variables are continuous, controllable and non-negative. That is ; $x_1 \geq 0$, $x_2 \geq 0$, . . ., $x_n \geq 0$. The decision variables $x_1, x_2, \ldots, x_n$ were constructed.
2. Objective function of the general form:

Optimize (Maximize or Minimize) $Z = c_1x_1 + c_2x_2 + \ldots, c_nx_n$.

Where Z is the measure of performance variables which is a function of $x_1, x_2, \ldots x_n$.

Quantities $c_1, c_2, \ldots, c_n$ are parameters that represent the contribution of a unit of the respective variable $x_1, x_2, \ldots, x_n$ to the measure of performance Z.

3. The constraints which are the limitations on the use of the use of resources which limit the degree to which the objective is to achieved were also made. These constraints were expressedas linear inequalities in terms of the decision variables. The solutions of linear programming model used satisfied the used constraints.

In this study, matlab algorithms is used due to its matrix language which intends primarily for numerical computation. According to Nikolaos P. and Nikolaos S., (2017), matlab is specially designed for matrix computations like solving systems of linear equations or factoring matrice. Furthermore,Matlabhas the ability to create concise codes.

MATHEMATICAL FORMULATION:

The following above general Linear Programming model, a model with n decision variables and m constraints was considered in this research.

Optimize(Max. or Min.) $P = c_1x_1 + c_2x_2 + c_nx_n$

Subject to the linear constraints,

$$a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n \quad (\leq, =, \geq)\ b_1$$

$$a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n \quad (\leq, =, \geq)\ b_2$$

$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots$$

$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots$$

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$a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n \quad (\leq, =, \geq) b_m$
and $x_1, x_2, \ldots, x_n \geq 0$
The above formulation also be written as

Optimize (Max. or Min.) $P = \sum_{j=1}^{n} c_j\, x_j$ (Objective function) (1)
Subject to the linear constraints

$\sum_{j=1}^{n} a_{ij}x_j \ (\leq, =, \geq) b_i\, ; i = 1,2, ..., m$ (Constraints) (2)
And $x_j \geq 0\, ; j = 1, 2, \ldots,, n$ (Non – negativity conditions)

Where, the $c_j\ s$ are coefficients representing the unit profit of decision variable x_j to the value of objective function. The a_{ij}'s are the technological coefficients which represent the amount of resources, assuming i consumed per unit of variable x_j. These coefficients can be positives, negatives or zero. The b_i stands for the total availability of the ith resource. The term resource is used in a very general sense to include any numerical value associated with the right – hand side of a constraint. It is assumed that $b_i \geq 0$ for all .

Method analysis
A function P, was considered.
To Maximize: $P = 2x_1 + 4x_2$ (3)

Subject to:
$x_1 + 5x_2 \leq 18$
$x_1 - 5x_2 \leq 12$
$x_1, x_2 \geq 0$
Where x_1 and $x_2$represents the input variables.

In application, x_1 and x_2 represents the quantities to be produced. For example; the quantities of two types of products which are constrained by 18 and 12 in monetary values per million of naira (₦).

Using the method of algebra, the following several feasible corner points that maximize the objective function were discovered. Also, the best corner point that produces the best objective function that is corresponding to the specified value of the constraint value of 18 was identified.

ANALYTICAL CALCULATIONS:

Objective Function:

Maximize: $P = 2x_1 + 4x_2$

Subject to : $x_1 + 5x_2 \leq 18$

$x_1 - 5x_2 \leq 12$

$x_1, x_2 \geq 0$.

For the initial condition,

$$x_1 + 5x_2 = 18 \quad (4)$$

-

$$x_1 - 5x_2 = 12 \quad (5)$$

$$10x_2 = 6$$

$$X_2 = 0.6 \quad (6)$$

$$X_1 = 18 - 5x_2$$

$$= 18 - 5(0.6)$$

$$= 18 - 3.0$$

$$X_1 = 15 \quad (7)$$

Testing for the satisfaction of the linear constraints:

If $x_1 = 15$, $x_2 = 0.6$,

Then, $x_1 + 5x_2 = 18$

$$15 + 5(0.6) = 18$$

$$15 + 3.0 = 18$$

$$18 = 18$$ (Linear constraints satisfied)

$$P = 2x_1 + 4x_2$$

$$= 2(15) + 4(0.6)$$

$$= 30 + 2.4$$

$$= 32.4$$

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Corner points: LC_1; $x_1 + 5x_2 = 18$, when $x_1 = 0$;

$0 + 5x_2 = 18$

$X_2 = 3.6$

When $x_2 = 0$,

$X_1 + 5(0) = 18$

$X_1 = 18$

Corner Points for LC_1: (0, 3.6), (18, 0)

$x_1 - 5x_2 = 12$,

when $x_1 = 0$, $0 - 5x_2 = 12$

$x_2 = -2.4$

(0, -2.4)

when $x_2 = 0$, $x_1 - 5x_2 = 12$

$x_1 - 5(0) = 12$

$x_1 = 12$

Corner Points for LC_2: (0 , -2.4) , (12 , 0)

Variation of Linear Constraint 18:

1. 25% variation of the first linear constraint (18)

18 x 0.25 = 4.5

$x_1 + 5x_2 = 4.5$

-

$x_1 - 5x_2 = 12$

$10x_2 = -7.5$

$x_2 = -0.75$

$x_1 = 4.5 - 5(-0.75)$

= 4.5 + 3.75

= 8.25

Testing for satisfaction of the linear constraints ;

$x_1 + 5x_2 = 4.5$

$8.25 + 5(-0.75) = 4.5$

$8.25 - 3.75 = 4.5$

$4.5 = 4.5$ Linear Constraints satisfied.

$P = 2x_1 + 4x_2$

$= 2(8.25) + 4(-0.75)$

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$= 16.5 - 3.0$

$= 13.5$

When $x_1 = 0$, $0 + 5x_2 = 4.5$

$x_2 = 0.9$

$(0, 0.9)$

When $x_2 = 0$, $x_1 + 5(0) = 4.5$

$x_1 = 4.5$

$(4.5, 0)$

Corner Points $(0, 0.9), (4.5, 0)$

2.60% variation of the first linear constraint (18);

$18 \times 0.6 = 10.8$

$x_1 + 5x_2 = 10.8$

-

$x_1 - 5x_2 = 12$

$10x_2 = -1.2$

$x_2 = -0.12$

$x_1 = 10.8 - 5(-0.12)$

$= 10.8 + 0.6$

$= 11.4$

Testing for the satisfaction of the linear constraints:

$x_1 + 5x_2 = 10.8$

$11.4 + 5(-0.12) = 10.8$

$11.4 - 0.6 = 10.8$

$10.8 = 10.8$ Linear constraints satisfied.

$P = 2x_1 + 4x_2$

$= 2(11.4) + 4(-0.12)$

$= 22.8 - 0.48$

$= 22.32$

When $x_1 = 0$, $0 + 5x_2 = 10.8$

$x_2 = 2.16$

$(0, 2.16)$

When $x_2 = 0$; $x_1 + 5(0) = 10.8$

$x_1 = 10.8$

(10.8 , 0)

Corner Points: (0 , 2.16) , (10.8 , 0)

3. 66% variation of the first linear constraint (18)

$18 \times 0.66 = 11.88$

$x_1 + 5x_2 = 11.88$

-

$x_1 - 5x_2 = 12$

$10x_2 = -0.12$

$x_2 = -0.012$

$x_1 = 11.88 - 5(-0.012)$

$x_1 = 11.88 + 0.06$

$x_1 = 11.94$

Testing for the satisfaction of the linear constraints;

$x_1 + 5x_2 = 11.88$

$11.94 + 5(-0.012) = 11.88$

$11.94 - 0.06 = 11.88$

$11.88 = 11.88$ Linear Constraints satisfied.

$P = 2x_1 + 4x_2$

$= 2(11.94) + 4(-0.012)$

$= 23.88 - 0.048$

$= 23.83$

When $x_1 = 0$; $0 + 5x_2 = 11.88$

$X_2 = 2.376$

(0, 2.376)

When $x_2 = 0$, $x_1 + 5(0) = 11.88$

$x_1 = 11.88$

(11.88 , 0)

Corner Points (0 ,2.376) , (11.88, 0)

4. 67% variation of the first linear constraints (18).

$18 \times 0.67 = 12.06$

$x_1 + 5x_2 = 12.06$

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$x_1 - 5x_2 = 12$

$10x_2 = 0.06$

$x_2 = 0.006$

$x_1 = 12.06 – 5(0.006)$

$= 12.06 – 0.03$

$= 12.03$

Testing for the satisfaction of the linear constraints:

$x_1 + 5x_2 = 12.06$

$12.03 + 5(0.006) = 12.06$

$12.03 + 0.03 = 12.06$

$12.06 = 12.06$ Linear Constraints satisfied.

$P = 2x_1 + 4x_2$

$= 2(12.03) + 4(0.006)$

$= 24.06 + 0.024$

$= 24.084$

When $x_1 = 0$, $0 + 5x_2 = 12.06$

$x_2 = 2.412$

(0, 2.412)

When $x_2 = 0$, $x_1 + 5(0) = 12.06$

$x_1 + 0 = 12.06$

$x_1 = 12.06$

(12.06 , 0)

Corner Points (0 , 2.412) , (12.06, 0)

5. 70% variation of the first linear constraint (18)

18 x 0.7 = 12.6

$x_1 + 5x_2 = 12.6$

-

$x_1 - 5x_2 = 12$

$10x_2 = 0.6$

$x_2 = 0.06$

$x_1 = 12.6 - 5(0.06)$

$= 12.6 – 0.3$

$= 12.3$

Testing for the satisfaction of the linear constraints:

$x_1 + 5x_2 = 12.6$

$12.3 + 5(0.06) = 12.6$

$12.3 + 0.3 = 12.6$

$12.6 = 12.6$ Linear Constraints satisfied.

$P = 2x_1 + 4x_2$

$= 2(12.3) + 4(0.06)$

$= 24.6 + 0.24$

$= 24.84$

When $x_1 = 0$, $0 + 5x_2 = 12.6$

$x_2 = 2.52$

(0,2.52)

When $x_2 = 0$, $x_1 + 5(0) = 12.6$

$x_1 + 0 = 12.6$

$x_1 = 12.6$

(12.6, 0)

Corner Points: (0, 2.52) , (12.6 , 0)

6. 101% variation of the first constraint (18)

$18 \times 1.01 = 18.18$

$x_1 + 5x_2 = 18.18$

-

$x_1 - 5x_2 = 12$

$10x_2 = 6.18$

$x_2 = 0.618$

$x_1 = 18.18 - 5(0.616)$

$= 18.18 – 3.09$

$= 15.09$

Testing for the satisfaction of the linear constraints:

$x_1 + 5x_2 = 18.18$

$15.09 + 5(0.618) = 18.18$

$15.09 + 3.09 = 18.18$

$18.18 = 18.18$ Linear Constraint satisfied.

$P = 2x_1 + 4x_2$

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$= 2(15.09) + 4(0.618)$
$= 30.18 + 2.472$
$= 32.652$

When $x_1 = 0$, $0 + 5x_2 = 18.18$
$X_2 = 3.636$
$(0, 3.636$

When $x_2 = 0$, $x_1 + 5(0) = 18.18$
$x_1 + 0 = 18.18$
$x_1 = 18.18$
$(18.18, 0)$

Corner Points : $(0, 3.636)$, $(18.18, 0)$

7. 105% variation of the first linear Constraint (18).

$18 \times 1.05 = 18.9$

$x_1 + 5x_2 = 18.9$

-

$x_1 - 5x_2 = 12$

$10x_2 = 6.9$

$x_2 = 0.69$

$x_1 = 18.9 - 5(0.69)$
$= 18.9 - 3.45$
$= 15.45$

Testing for the satisfaction of the linear constraints:

$x_1 + 5x_2 = 18.9$
$15.45 + 5(0.69) = 18.9$
$15.45 + 3.45 = 18.9$
$18.9 = 18.9$ Linear Constraint satisfied.

$P = 2x_1 + 4x_2$
$= 2(15.45) + 4(0.69)$
$= 30.9 + 2.76$
$= 33.66$

When $x_1 = 0$, $0 + 5x_2 = 18.9$
$x_2 = 3.78$
$(0, 3.78)$

When $x_2 = 0$, $x_1 + 5(0) = 18.9$

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$x_1 + 0 = 18.9$

$x_1 = 18.9$

$(18.9, 0)$

Corner Points: $(0, 3.78), (18.9, 0)$

8. 110% variation of the first linear constraint (18).

$18 \times 1.1 = 19.9$

$x_1 + 5x_2 = 19.9$

-

$x_1 - 5x_2 = 12$

$10x_2 = 7.9$

$x_2 = 0.79$

$x_1 = 19.9 - 5(0.79)$

$= 19.9 - 3.95$

$= 15.95$

Testing for the satisfaction of the linear constraints

$x_1 + 5x_2 = 19.9$

$15.95 + 5(0.79) = 19.9$

$15,95 + 3.95 = 19.9$

$19.9 = 19.9$ Linear Constraint satisfied.

$P = 2x_1 + 4x_2$

$= 2(15.95) + 4(0.79)$

$= 31.9 + 3.16$

$= 35.06$

When $x_1 = 0$, $0 + 5x_2 = 19.9$

$x_2 = 3.98$

$(0, 3.98)$

When $x_2 = 0$, $x_1 + 5(0) = 19.9$

$x_1 + 0 = 19.9$

$x_1 = 19.9$

$(19.9, 0)$

Corner Points: $(0, 3.98)$, $(19.9, 0)$

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Table 1

SUMMARY TABLE ON THE VARIATION OF THE FIRST LINEAR CONSTRAINT (18) TO THE OBJECTIVE FUNCTION FROM ANALYTICAL CALCULATION

EXAMPLES	VARIATION PERCENTAGE	CONSTRAINT 1	CONSTRAINT 2	X_1	X_2	P
1	Original (Initial)	18	12	15	0.6	32.4
2	10	1.8	12	6.9	-1.02	9.72
3	20	3.6	12	7.8	-0.84	12.24
4	2.5	4.5	12	8.25	-0.75	13.5
5	60	10.8	12	11.4	-0.12	22.32
6	64	11.52	12	11.76	-0.048	23.288
7	65	11.7	12	11.85	-0.03	23.58
8	66	11.88	12	11.94	-0.012	23.832
9	67	12.06	12	12.03	0.006	24.084
10	70	12.6	12	12.3	0.06	24.84
11	75	13.5	12	12.75	0.15	26.1
12	80	14.4	12	13.2	0.24	27.36
13	85	15.3	12	13.65	0.33	28.62
14	90	16.2	12	14.1	0.42	29.88
15	95	17.1	12	14.55	0.51	31.14
16	98	17.64	12	14.82	0.564	31.896
17	99	19.82	12	14.91	0.582	32.148
18	101	18.18	12	15.09	0.618	32.652
19	105	18.9	12	15.45	0.69	33.66
20	110	19.9	12	15.95	0.79	35.06

After the analytical calculations, a matlabalgorithms was applied to obtain the following results:

Table2a: Displays the outcome of the 25% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLE	8.2500	4.5000	0	12.0000	0
	0.7500	0	3.6000	0	-2.4000
OBJECTIVE	13.5000	9.0000	14.4000	24.0000	-9.6000

Table2b: Displays the outcome of the 60% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	11.4000	10.8000	0	12.0000	0
	0.1200	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	22.3200	21.6000	14.4000	24.0000	-9.6000

Table2c: Displays the outcome of the 64% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	11.7600	11.5200	0	12.0000	0
	0.0480	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	23.3280	23.0400	14.4000	24.0000	-9.6000

Table2d: Displays the outcome of the 65% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	11.8500	11.7000	0	12.0000	0
	0.0300	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	23.5800	23.4000	14.4000	24.0000	-9.6000

Table2e: Displays the outcome of the 66% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	11.9400	1.8800	10	12.0000	0
	0.0120	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	23.8320	23.7600	14.4000	24.0000	-9.6000

Table2f: Displays the outcome of the 67% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	12.0300	12.0600	0	12.0000	0
	0.0060	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	24.0840	24.1200	14.4000	24.0000	-9.6000

Table2g: Displays the outcome of the 70% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	12.3000	12.6000	0	12.0000	0
	0.0600	0	3.6000	0	2.4000
OBJECTIVE FUNCTION	24.8400	25.2000	14.4000	24.0000	-9.6000

Table2h: Displays the outcome of the 75% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	12.7500	13.5000	0	12.0000	0
	0.1500	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	26.1000	27.0000	14.4000	24.0000	-9.6000

Table2i: Displays the outcome of the 80% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	13.2000	14.4000	0	12.0000	0
	0.2400	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	27.3600	28.8000	14.4000	24.0000	-9.6000

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Table2j: Displays the outcome of the 85% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	13.6500	15.3000	0	12.0000	0
	0.3300	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	28.6200	30.6000	14.4000	24.0000	-9.6000

Table2k: Displays the outcome of the 90% of 18 (the first constraint) when
12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS

DECISION VARIABLES	14.1000	16.2000	0	12.0000	0
	0.4200	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	29.8800	32.4000	14. 4000	24.0000	-9.6000

Table2m: Displays the outcome of the 95% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	14.5500	17.1000	0	12.0000	0
	0.5100	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	31.1400	34.2000	14.4000	24.0000	-9.6000

Table2n: Displays the outcome of the 96% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	14.6400	17.2800	0	12.0000	0
	0.5280	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	31.3920	34.5600	14.4000	24.0000	-9.6000

Table2o: Displays the outcome of the 97% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	14.7300	17.4600	0	12.0000	0
	0.5460	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	31.6440	34.9300	14.4000	24.0000	-9.6000

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Table2p: Displays the outcome of the 98% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	14.8200	6400	0	12.0000	0
	0.5640	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	31.8960	35.2800	14.4000	24.0000	-9.6000

Table2q: Displays the outcome of the 99% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	14.9100	17.8200	0	12.0000	0
	0.5820	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	32.1480	35.6400	14.4000	24.0000	-9.6000

Table2r: Displays the outcome of the 101% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	15.0900	18.1800	0	12.0000	0
	0.6180	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	32.6520	36.3600	14.4000	24.0000	-9.6000

Table2s: Displays the outcome of the 105% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	15.4500	18.9000	0	12.0000	0
	0.6900	0	3. 6000	0	-2.4000

OBJECTIVE FUNCTION	33.6600	37.8000	14.4 000	24.0000	-9.6000

Table2t: Displays the outcome of the 110% of 18 (the first constraint) when 12 (the second constraint) was fixed.

	FEASIBLE CORNER POINTS				
DECISION VARIABLES	15.9000	19.8000	0	12.0000	0
	0.7800	0	3.6000	0	-2.4000
OBJECTIVE FUNCTION	34.9200	39.6000	14.400	24.0000	-9.6000

RESULTS AND DISCUSSION:

Table 1 isa summary table on the impact of the variation of the first linear constraint (18) to the objective function from analytical calculations. In this table, x_1, x_2, and P represents the decision variables (x_1 , x_2) and P is the objective function. The table shows the initial feasible solution for the original linear programming simultaneous equations as 32.4 with the initial decision variables x_1 and x_2 values as 15 and 0.6 respectively. As the second linear constraint (12) was fixed, and the linear constraint (18) varied at different percentage degrees, the table shows different calculated values of the decision variables with their corresponding objective function (P) values which is feasible corner points. The result shows some degenerate feasible corner points. These corner points have invalid decision production. The table also shows the transition of the negative values of the second decision variable into positive values at 67% variation of 18. From the table 1 result too, the best feasible unique corner point was identified at 105% variation of 18 with x_1 and x_2 (decision variables) values of 15.45 and 0.69 respectively with the objective function value of 33.66. Bifurcation point which is the point at which objective function value (P) becomes a little above the initial (original) value of P (32.4) occurred at 101% variation of 18 with a P value of 32.652. Tables 2a to table2t shows matlab computerized results which are similar to the analytical calculation values. In table 2a, is the 25% variation of 18.The first column on the feasible corner point row is the corner point values of (x_1, x_2) and its corresponding objective function P value. The second and third columns are the same at different feasible points but columns 4 and 5, shows the computational feasible corner points values of fixed second linear constraint (12) with their corresponding objective functions (P). The first row shows the values of the first decision variable (x_1) all through. The second row shows the values of the second decision variable (x_2) all through. The third row shows the values of the computed objective functions(P). The same thing happens in all matlab computed tables from table 2a to table 2t. The results are the same as the ones explained analytical calculations.

The result shows several feasible corner points that maximize the objective function. The best corner point that produces the best objective function that is corresponding to the specified value of the constraint value of 18 is identified.

CONCLUSION:

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This study has found that a transition from a negative x_2($-x_2$) to a positive x_2 has occurred between 66 and 67 variation of constraint value of 18 when the other constraint is fixed. At 105 percent (105%), variation of 18, the value of x_1 is equal to 15.45, the value of x_2 is 0.69 and the value of P IS 33.6.

$$(15.45, 0.69) \rightarrow P = 33.6$$

In summary, though the corner point (18.9, 0) produced bigger value of P, it remains a degenerate feasible point which will produce invalid production decision,the positive unique feasible point(15.45, 0.69) remains the best fit feasible corner point within the feasible region which maximizes the chosen objectives function .

RECOMMENDATIONS:

Comparing the analytical calculation results with the matlab computational report, the study has shown that they are some degenerate feasible solutions which will yield invalid production decision. Also, that among other feasible solutions, unique feasible solutions exist at the corner points where both linear constraints have positive values. Hence in decision, to optimize the profit by maximizing the production, the decision makers or the managerial team have to increase the percentage variation of linear constraint above the bifurcation unique point (limit) in other to obtain the best feasible unique solutions which will maximize their production.

To optimize the profit, the decision makers can increase their objective function by adding a positive constant value to the already existing objective function.

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REFERENCES

Euler, L.(1783), Swiss mathematician and physicist, 1707 – 1783.

Hindawi, (2020), *Journal of Applied Mathematics volume 2020,Article ID8817909, 7 pages*.https://doi.org/10.1155/2020/8817909.

Michael L.O (1997). Draft for Encyclopedia Americana,December 20, 2020.

Michael C. F., Olvi L., Mangasarian S. and Wright J., (2007). Linear Programming with Matlab published:2007, pages:Y1+266 soft core.

Murthy P.R. (2007), Operation Research . http://www.bbau.ac.in>UIET PDF. New age INT publisher.

Nikolaos P. and Nikolaos S., (2017). Linear Programming using matlab. DOI: 10 . 1007/978- 3 - 319 - 65919 – 0 ISBN: 978 – 3 – 319 – 65917 – 6. June 21, 2017.

Omalley, M. J. (1973). Linear Programming and its application to pattern Recognition Problems. Science. Gov (United State) (993- 01 -01)