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An Optimization of Inventory in Retrospect of the Directorate of Physical Planning in Ambrose Alli University Ekpoma, Edo State

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Abstract

This study proposes a mathematical model for the Directorate of Physical Planning's inventory materials at Ambrose Alli University in Ekpoma, Edo State. To minimize the total cost for the year 2015, the study uses the linear programming solver (MATLAB's linprog solver). To give the most efficient inventory among the products purchased, as well as the ideal minimum cost for the inventory, program codes 1 and 2 with upper bounds were employed. Program codes 1 with an upper bound attained the required results for the year, however program codes 2 without an upper bound were unable to do so, showing that their optimization method was under-performing in terms of cost minimization.

1. Introduction

Optimization concerns the minimization or maximization of functions. Absence of inventory optimization is a common design problem that makes it more difficult to accurately plan and forecast future inventory needs in organizations, industries, educational sectors and establishments whether large, medium or small scale [1]. A well-designed inventory system must capture the right data at the right time to avoid ordering mistakes that result in inaccurate inventory levels. Optimization

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is especially important as a cost-control measure in a manufacturing business, because it functions both to reduce waste and improve serviceability [2] and [3]. A design solution can be to incorporate clearly written standard operating procedures for checking in and storing inventory items and instituting periodic physical inventory counts [4] and [5]. Optimization of inventory emerged as a proven technology to drastically reduce total inventory levels while improving customer service levels. Inventory optimization is now recognized by leading companies as a core competency critical to their success [4]. Some scholars like [6] and [7] emphasized that the overall goal of inventory management is to have what is needed when it is needed and to minimize the number of times one is out of stock.
The modern theory of inventory offers a variety of economic and mathematical models of inventory system in achieving optimal inventory policy [8], [9], [10] and [11]. The basic problem of inventory management is to determine the optimal stock size and optimal reorder size. The inventory at hand at any time (t) is given by:

$$I(t) = Lo + \int_o^t [a(Q) - b(Q)]\, dQ \tag{1}$$

where $a(Q)$ = Supply rate/unit time, $b(Q)$ = Demand rate/unit time and L_O = Initial starting Inventory level. The optimal stocking decision for periodic review models should satisfy the optimality conditions given by [12] as:

$$Pr.(D \leq S^*) = \frac{p}{h+p} \tag{2}$$

where D is the initial Inventory level, S^* is the pr is the probability of the stocking decision for the review model, h is the and $\frac{p}{h+p}$ is known as the critical ratio. The optimal policy for a newspaper vendor problem is to order up to S^* whenever the initial inventory level (D) is below S^*, otherwise do not place an order. In this case, the optimal policy will place orders only when the initial inventory level is below a threshold $s < S^*$, given by [13], [14] and [15] as:

$$G(s) = G(S^*) + K \tag{3}$$

In order to analyze continuous-review inventory systems, a demand process should be specified. The inventory position is:

$$Pr(IP = K) = \frac{m_k}{\sum_{j=s+1}^{k} m_j}, \text{ for } j = s+1,\ j = s+2,\ j = s-1, \tag{4}$$

where $m_{\boldsymbol{j}} = \sum_{k=j+1}^{s} m_{\boldsymbol{k}} \cdot \Psi(k-j)$ is the average number of visits to $IP = j$ during a replenishment cycle.

The optimization of inventory has become an area of major concern in organizations, academic environments and establishments. The Directorate of Physical Planning in Ambrose Alli University, Ekpoma is our reference point for the development process of optimizing inventory supplied. The ability to formulate mathematical model and a linear programming model by using the linprog solver to the supply of the inventories will no doubt be of reliable benefits as there is the possibility of optimizing the supplied quantity by considering the issue of cost benefit analysis and in addition use such results to determine the optimal solution of the inventory. There is need to formulate a linear programming model to the supply activities of the Directorate which will be of immense benefit as there is the possibility of analyzing such results to determine the best solution for the University.

This study provides a solution for the effective procurement and distribution of inventories in the Directorate of Physical Planning in Ambrose Alli University, Ekpoma. The inventory model of the facilities purchased is formulated and applied the linear programming solver to optimize the inventory cost. The research formulate mathematical model that would describe the behaviour of the inventory system in Directorate of Physical Planning in Ambrose Alli University, Ekpoma; obtain optimal solution for the inventory policy with regard to the model under review; and design a computerize information processing system that will help to maintain records of current inventory levels.

2. Research Method

Most industrial problems in manufacturing organizations of the economy can be expressed in terms of measurable parameters, with the objective to monitor and control relevant production processes for purposes of optimizing resources. For cases where the problems (production constraints) can be mathematically expressed as linear inequalities with the objective to optimize a linear function, the production problem can be categorized as a linear optimization problem. Optimization of production scheduling as linear programming model permits the optimal realization of objective based decisions to reduce production and inventory costs and maximize profit, if all relevant constraints can be rightly identified. Primary method of data collection was adopted in gathering the necessary data in this dissertation and the necessary data attached. Mathematical formulation of the inventory of the purchased items was carried out and an application package called the linprog solver of the MATLAB was employed to optimize the cost of inventory purchased, obtained the optimal solution for the inventory model and designed a computerize information processing system to help maintain records of current inventory levels for the Directorate of Physical Planning in Ambrose Alli University Ekpoma on Desktop Computers, Laptops, Printers, Air-conditioners, Fire-Proof Cabinets and Voltage Regulators. The above method was employed

to address the stated objectives for the purpose of optimizing the inventory problems. The methods used in this research are:

2.1. **Linear programming approach.** This is a class of optimization problems where both the objective function to be maximized or minimized and the constraints are linear. It can also be seen as a method of determining an optimum program of inter-dependent activities which are competing for limited resources under assumptions of linearity. Linear programming models can generally be represented as:

$$Max\ Z = \sum_{j=1}^{n} C_J x_j \text{ i.e. } c_1x_1 + c_2x_2 + \ldots., + c_nx_n \tag{5}$$

Subject to

$$\sum_{J=1}^{N} a_{ij}a_j \ = \ b_i \tag{6}$$

where $x_j = 0, j = 1, 2, \cdots, n$, x_j=level of activity $j(j = 1, \cdots, n,\ c_j)$ = Performance measure coefficient for activity j^{th} produced b_i= maximum amount of resources i available $(i = 1, \cdots, n)$ and a_{ij}= amount of resources i required to produce one unit of activity x_j.

2.2. **Integer programming approach.** An Integer linear programming is an optimization problem in which all or some of the variables are integers. Integer programming problem is a linear programming problem which can be expressed in canonical form as:

$$\text{Maximize } \ c^T x \tag{7}$$

Subject to:

$$Ax = b \tag{8}$$

$$x \geq 0 \ \text{ and integral} \tag{9}$$

where A is an $m \times n$ matrix, b is m-dimensional while c and x are n-dimensional vectors. In addition, Integer programming (IP) can be seen as an important technique used in dealing with problems that arise frequently in diverse fields such as capital budgeting, production planning, capacity planning, scheduling, chemical engineering process and inventory production and distribution, where fractional production are not required.

A mathematical optimization problem is one in which some function is either maximized or minimized relative to a given set of alternatives. Linear programming is an extremely powerful tool for addressing a wide range of applied optimization problems. Simplex tableau is used to perform row operations on the linear

programming model as well as for checking optimality. The purchased items are the materials and are denoted by the parameter $'x'$ while the cost of each item is represented by the parameter $'c'$.
Let x_1 represent the quantities of Desktop Computers supplied, x_2 represent the quantities of Laptops supplied, x_3 represent the quantities of Printers, supplied, x_4 represent the quantities of Air Conditioners supplied, x_5 represent the quantities of Fire Proof Cabinets supplied, x_6 represent the quantities of Voltage Regulators purchased and Z represent the objective function.
There is therefore the need to minimize the total cost defined as C_1, C_2, C_3, C_4, C_5 and C_6 of the materials for each year hence we have to consider the purchase for the first year and proceeded after obtaining the optimal solution to do same for the second year. The objective is to minimize the total cost of the quantities of the products purchased by the Directorate of Physical Planning (DPP) in Ambrose Alli University, Ekpoma. The formulation of the linear program for the Directorate takes the form:

$$\text{Minimize } Z = \sum_{J=1}^{n} C_1x_1, C_2x_2, \cdots, C_nx_n \tag{10}$$

$$\text{Minimize } Z = C_1x_1 + C_2x_2 + \cdots + C_nx_n \tag{11}$$

$$\text{Minimize } Z = C_1x_1 + C_2x_2 + C_3x_3 + C_4x_4 + C_5x_5 + C_6x_6 \tag{12}$$

The design program is X =LINPROG$(c, A, b, Aeq, beq, LB, UB)$ defines a set of lower and upper bounds on the design variables $'X'$ so that the solution is in the range $LB \Leftarrow X \Leftarrow UB$. linprog solves linear programming problems.

$$[X,\ \text{objective value}] = \text{linprog}(c, A, b, Aeq, beq, LB, UB) \tag{13}$$

for $x_i > 0,\ (i = 1, 2, \cdots, 6)$ where all the x_i's are non negative or for $j = 1 : 6$
This is for obtaining optimal solution of program code 1 with upper bound while the design program for obtaining optimal solution of program code 2 without upper bound is as defined below:

$$[X,\ \text{objective value}] = \text{linprog}(c, A, b, Aeq, beq, LB) \tag{14}$$

for $x_i > 0,\ (i = 1, 2, \cdots, 5)$ where all the $x_{i's}$ are non negative or for $j = 1 : 5$
MATLAB was employed to handle the linear programming problem. These are problems in which you have a quantity, depending linearly on several variables that you want to maximize or minimize subject to several constraints that are expressed as linear inequalities with the same variables.

3. Results and Analysis

3.1. **Inventory Items and their Associated cost.** The available data provided by the Directorate of Physical Planning of the University for 2015 and 2016 is shown in Table 1.

Table 1: Inventory of items and their Associated cost for 2015

Items	Available Quantities in 2015	Cost per item in 2015 (N)
Desktop computers	250	120000
Laptops	278	140000
Printers	300	75000
Air conditioners	305	55000
Fire proof cabinets	285	64000
Voltage regulators	670	18000

Source: Directorate of Physical Planning, Ambrose Alli University, Ekpoma.

Budget for 2015 = N138,495,000
However, a simple computation of the inventory and associated cost for 2015 is presented in Table 2 below.

Table 2: Inventory and Associated Cost for 2015

Material	**Available Quantities in 2015**	**Unit Cost per item Available in 2015** (N)	**Total cost per item** (N)
Desktop computers	250	120000	30000000
Laptops	278	140000	38920000
Printers	300	75000	22500000
Air conditioners	305	55000	16775000
Fire proof cabinets	285	64000	18240000
Voltage regulators	670	18000	12060000
Overall Total	**2088**	**472000**	**138495000**

There need to minimize the total cost of the materials for each year, hence, the need to consider the purchase for the first year (2015). The objective is to minimize the total cost of the product purchased by the Directorate of Physical Planning (DPP) in Ambrose Alli University, Ekpoma. Thus: applying equation (11) given as:
Minimize $Z = C_1x_1 + C_2x_2 + C_3x_3 + C_4x_4 + C_5x_5 + C_6x_6$, which results to Minimize

$$Z = 120000x_1 + 140000x_2 + 75000x_3 + 55000x_4 + 64000x_5 + 18000x_6 \quad (15)$$

Subject to the following constraints equations:

Constraint 1
The total unit cost of all the items should be less than or equal to total amount meant for purchase of all items. That is, total cost of each item is restricted to the budget constraint. The total budget which can be allocated is N 138495000 and the individual costs per Desktop Computers, Laptops, Printers, Air conditioners, Fire Proof Cabinets and Voltage Regulators purchased is N 12000, N 14000, N75000, N55000, N64000 and N180001 respectively. This can be represented by the equation,

$$120000x_1 + 140000x_2 + 75000\,x_3 + 55000x_4 + 64000x_5 + 18000x_6 \leq 138495000$$

Reducing the constraint further to its lowest term gives the expression below:

$$1.2x_1 + 1.4x_2 + 0.75\,x_3 + 0.55x_4 + 0.64x_5 + 0.18x_6 \leq 1384.95 \quad (16)$$

Constraint 2
The total cost of Desktop computers and Laptops is less than or equal to total sum of money allocated for the purchase of the required desktop computers and laptops. The individual costs per Desktop Computers and Laptops purchased are $N120,000$ and $N140,000$ while the total sum of the two individual items is $N68,920,000$. This can be represented by the equation:
$120000x_1 + 14000x_2 = 68920000$
Reducing the expression further yields:

$$6x_1 + 7x_2 = 3446 \tag{17}$$

Constraint 3
The sum total of Unit cost of Desktop computers, Unit cost of Laptops and unit cost of Printers is equated to be equal to the total amount allocated for their purchase. That is, the sum of N 30, 000,000; N 38, 920,000 and N 22, 500,000 was respectively used for the purchase of Desktop computers, Laptops and Printers respectively as earmarked. This can be mathematically represented as:
Cost of Desktop computers + Laptops + Printers = 91420000

$$120000x_1 + 140000x_2 + 75000\ x_3 = 91420000$$

Reducing the expression further yields

$$12x_1 + 14x_2 + 7.5\ x_3 = 9142 \tag{18}$$

Constraint 4
This is equally an equality constraint. The sum of the entire inventory items to be supplied or purchased (ie Desk top computers, Laptops, Printers, Air conditioners, Fire Proof Cabinets, and Voltage Regulators) is subjected to a total number specified by the researcher in order to enhance quality control; otherwise we may get a result that may be outrageous or underutilized. A total stock of 1900 inventories needed to be purchased as a choice.

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 = 1900 \tag{19}$$

Constraint 5
The sum of eighteen million naira is set aside for the purchase of Air conditioners and Voltage Regulators. That is, Air-conditioners + Voltage Regulators = 28825000.

$$55000x_4 + 18000\ x_6 = 28825000$$

Further reduction of the expression yields

$$55x_4 + 18x_6 = 28825 \tag{20}$$

Constraint 6
The available quantities of inventory items were used to set an upper bound for the program:

$$x_1 \leq 250;\ ; x_2 \leq 278; x_3 \leq 300; x_4 \leq 305;\ x_5 \leq 285;\ x_6 \leq 670 \tag{21}$$

The linear equation is converted from mathematical forms into vector forms.

$$Z = (120000\ 140000\ 75000\ 55000\ 64000\ 180000) \tag{22}$$

A total of two and three linear inequalities constraints in six variables in each case created. Then, matrix A (2×6) matrix is created, corresponding to two linear inequalities in six variables, and vector b with two elements. The resulting matrix A for the Inequality constraints is as depicted below:

$$A = \begin{bmatrix} 1.2 & 1.4 & 0.75 & 0.55 & 0.64 & 0.18 \\ 6 & 7 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{23}$$

$$b = \begin{bmatrix} 1384.95 \\ 3446 \end{bmatrix} \tag{24}$$

Also, a matrix A $(3X6)$ is formed, corresponding to three linear equalities in six variables, and vector b with three elements: in order to have the equations in the form $Aeq = beq$ in six variables and the vector beq with three elements.

$$Aeq = \begin{bmatrix} 12 & 14 & 7.5 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 55 & 0 & 18 \end{bmatrix} \tag{25}$$

$$beq = \begin{bmatrix} 9142 \\ 1900 \\ 28825 \end{bmatrix} \tag{26}$$

A lower bound lb and upper bound ub is then created as specified below:

$$lb = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \tag{27}$$

$$ub = \begin{bmatrix} 250 \\ 278 \\ 300 \\ 305 \\ 285 \\ 670 \end{bmatrix} \tag{28}$$

$$c = \begin{bmatrix} 120000 \\ 140000 \\ 75000 \\ 55000 \\ 64000 \\ 18000 \end{bmatrix} \tag{29}$$

where A= the matrix of the linear inequality constraints, b = the right hand side vector of the linear inequality constraints, Aeq = the matrix of the linear equality constraints, beq = the right hand side vector of the linear equality constraints, lb = the vector of the lower bounds, ub = the vector of the upper bounds and c = vector of the objective function.

3.2. **Optimal solution for 2015 budget.** The linprog solver of MATLAB is used in order to get the optimal solution for the established programme: This is done in order to see if the result of cost minimization for the programmes is satisfied, validated and to determine the amount that have been saved as profit for the directorate. Applying the Design formula in the linprog of MATLAB defined in (13). Table 3 is then obtained. The Optimal solution for 2015 budget then follows:

$$X, \text{objective value} = \text{linprog}(c, A, b, Aeq, beq, lb, ub)$$

for $(x_i > 0,\ i = 1, 2, \cdots, 6)$ where all the x_i's are non negative or for $j = 1 : 6$

3.3. **Program code 1 (with upper bound).** The program code 1 with upper bound is hereby given as follows:

A = [1.2 1.4 0.75 0.55 0.64 0.18; 6 7 0 0 0 0]; % create the matrix A
b = [1384.95; 3446] create the vector b
Aeq= [12 14 7.5 0 0 0; 1 1 1 1 1 1;0 0 0 55 0 18] create the matrix Aeq
beq= [9142; 1900; 28825]; % creates the vector beq
lb = [0 0 0 0 0 0]; % create the vector lb
ub = [250 278 300 305 285 670]
c = [120000; 140000; 75000; 55000; 64000; 18000]; % creates the vector c
% call the linprog solver
[X, objective Value]=linprog(c,A,b,Aeq, beq, lb,ub)

For $i = 1 : 6$ % print results in formatted form
Fprintf ('x%d\t %20.4f\n',i,x(i))
end
fprintf(['The value of the objective function"is%.4f\n'],objective Value)

Table 3: Optimal solution for 2015 budget

Variables $x_{i's}$	**Value**
x_1	250.00
x_2	267.86
x_3	300.00
x_4	304.14
x_5	108.00
x_6	670.00
Z	**125699857.14**

The value of the objective function is 125699857.14. The implication of the above inventory optimization program can be interpreted from the optimal solution as follows: The Directorate of Physical Planning of the university should purchase 250 Desktop Computers; 268 Laptops; 300 Printers; 304 Air-conditioners; 108 Fireproofs Cabinets and 670 Voltage Regulators at a total cost of N125, 699,857.1429 with a favourable balance of N12, 795,142.86.

3.4. **Program code 2 (without upper bound).** There is need to minimize the total cost of the materials for each year hence we have to consider the purchase for the first year (2015). Thus: from (11).

(30) Minimize $Z = 120000x_1+140000x_2+75000x_3+55000x_4+64000x_5+18000x_6$

Subject to the following constraints equations:

Constraint 1
The total cost of each item is restricted to the budget constraint. The total budget which can be allocated is N138495000 and the individual costs per Desktop Computers, Laptops, Printers, Air conditioners, Fire Proof Cabinets and Voltage Regulators purchased is N12000, N14000, N75000, N55000, N64000 and N180001 respectively. This can be represented by the equation

$120000x_1 + 140000x_2 + 75000\,x_3 + 55000x_4 + 64000x_5 + 18000x_6 \leq 138495000$

Reducing the constraint further to its lowest term gives the expression below:

(31) $1.2x_1 + 1.4x_2 + 0.75\,x_3 + 0.55x_4 + 0.64x_5 + 0.18x_6 \leq 1384.95$

Constraint 2
The total cost of Desktop computers and Laptops is less than or equal to total sum of money allocated for the purchase of the required desktop computers and laptops. The individual costs per Desktop Computers and Laptops purchased are
N120000 and N140000 while the total sum of the two individual items is N68920000
This can be represented by the equation, $120000x_1 + 14000x_2 = 68920000$
Reducing the expression further yields:

$$6x_1 + 7x_2 = 3446 \tag{32}$$

Constraint 3
The sum total of Unit cost of Desktop computers, Laptops and Printers is equated to be equal to the total amount allocated for their purchase. That is, the sum of N30, 000,000; N38, 920,000 and N22,500,000 respectively was used for the purchase of the items. This can be mathematically represented as: Cost of Desktop computers + Laptops + Printers = 91420000
$120000x_1 + 140000x_2 + 75000\ x_3 = 91420000$. Reducing the expression further yields

$$12x_1 + 14x_2 + 7.5\ x_3 = 9142 \tag{33}$$

Constraint 4
The sum of the entire inventory items (Desk top computers, Laptops, Printers, Air conditioners, Fire Proof Cabinets, and Voltage Regulators) to be supplied or purchased is subjected to a total number specified by the researcher in order to enhance quality control; otherwise, we may get a result that may be outrageous or underutilized. A total stock of 1900 inventories needed to be purchased as a choice.

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 = 1900 \tag{34}$$

Constraint 5
The sum of eighteen million naira is set aside for the purchase of Air conditioners and Voltage Regulators. That is Air-conditioners + Voltage Regulators = 28825000

$$55000x_4 + 18000\ x_6 = 28825000$$

Further reduction of the expression yields

$$55x_4 + 18x_6 = 28825 \tag{35}$$

The linear equations are then converted from mathematical forms into vector forms.

$$Z = (120000\ 140000\ 75000\ 55000\ 64000\ 180000) \tag{36}$$

A total of two and three linear equalities constraints in six variables in each case are formed. Then, a matrix A (2×6) is created corresponding to two linear inequalities in six variables, and vector b with two elements. The resulting matrix A for the inequality constraints is as depicted below:

$$A = \begin{bmatrix} 1.2 & 1.4 & 0.75 & 0.55 & 0.64 & 0.18 \\ 6 & 7 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{37}$$

$$b = \begin{bmatrix} 1384.95 \\ 3446 \end{bmatrix} \tag{38}$$

A matrix A (3×6) is also created, corresponding to three linear equalities in six variables and vector b with three elements. In order to have the equations in the form $Aeq = beq$ in six variables and the vector beq with three elements as shown below:

$$Aeq = \begin{bmatrix} 12 & 14 & 7.5 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 55 & 0 & 18 \end{bmatrix} \tag{39}$$

$$beq = \begin{bmatrix} 9142 \\ 1900 \\ 28825 \end{bmatrix} \tag{40}$$

The need to create the lower bound (lb) and upper bound (ub) as specified below

$$lb = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \tag{41}$$

$$c = \begin{bmatrix} 120000 \\ 140000 \\ 75000 \\ 55000 \\ 64000 \\ 18000 \end{bmatrix} \tag{42}$$

The linprog solver of MATLAB is also used in order to get the optimal solution for the established programme. This is done in order to see if the result of cost

minimization for the programmes is satisfied, validated and to determine the amount that have been saved as profit for the directorate.
Thus: $X = \text{LINPROG}(c, A, b, Aeq, beq, LB, UB)$ defines a set of lower and upper bounds on the design variables, X, so that the solution is in the range $LB \Leftarrow X \Leftarrow= UB$. linprog solves linear programming problems.

$$[X, \text{objective value}] = \text{linprog}(c, A, b, Aeq, beq, lb) \tag{43}$$

for $x_i > 0$, $(i = 1, 2, \cdots, 5)$ where all the x_i's are non-negative or for $j = 1 : 5$

Program code 1 (with upper bound)
A =[1.2 1.4 0.75 0.55 0.64 0.18; 6 7 0 0 0 0]; % create the matrix A
b =[1384.95; 3446] create the vector b
Aeq.= [12 14 7.5 0 0 0; 1 1 1 1 1 1;0 0 0 55 0 18] create the matrix Aeq
beq= [9142; 1900; 28825]; % creates the vector beq
lb = [0 0 0 0 0 0]; % create the vector lb
c = [120000; 140000; 75000; 55000; 64000; 18000]; %creates the vector c
% call the linprog solver
[X, objective Value]=linprog(c, A, b, Aeq, beq, lb);
For $i = 1 : 5$ % print results in formatted form
Fprintf ('x%d\t %20.4f\n',i,x(i))
end
fprintf(['The value of the objective function"is%.4f\n'],objective Value)

Table 4: Optimal solution for 2015 budget

Variables $x_{i's}$	**Value**
x_1	0.00
x_2	0.00
x_3	1200.00
x_4	0.00
x_5	0.00
x_6	1000.00
Z	108000000.00

The value of the objective function is 108000000.00
The implication of the above inventory optimization program can be interpreted from the optimal solution to mean that: the DPP should not purchase items like Desktop Computers; Laptops; Air Conditioners and Fire Proof Cabinets because a total of 1200 units of Printers and 1000 units of Voltage Regulators purchased at a minimized total cost of one hundred and eight million naira (N108,000,000.00).

It is observed that, this is not good enough as it is not a true representation of the desired items needed to be purchased in the directorate. This is for the fact that a total sum of thirty million, four hundred and ninety five thousand naira (N30495000.00) from the budgeted allocation is unutilized.

Summary. A mathematical model for the inventory materials of the Directorate of Physical Planning in Ambrose Alli University, Ekpoma, Edo State was developed. The linear programming solver (linprog solver of the MATLAB) to minimize the total cost for the year 2015. Programme codes 1 and 2 with upper bounds were used to provide the most optimized inventory among the items purchased, as well as the optimal minimal cost for the inventory. Program codes 1 with an upper bound achieved the desired results for the respective year, whereas program codes 2 without an upper bound were unable to achieve the desired results, indicating that their optimization process was performing poorly in terms of cost minimization.

Conclusion. The Directorate of Physical Planning's inventory optimization was the focus of this paper. The inventories of the products that were given were modeled. Six constraints were used in code 1 (with upper bound) to represent the inventory materials of each purchase, while five constraints were used in code 2 (without upper bound) to minimize the purchased cost. The solution was found using the linprog solver, and an analysis of the optimized results revealed that the code with upper bound produced better results than the code without.

Recommendation. It is therefore recommended that the management of Ambrose Alli University, Ekpoma's Directorate of Physical Planning, as well as other purchasing or procurement officers and managers in general, use mathematical formulations of models and linprog solver with bounded codes to effectively determine the most efficient way of allocating their limited funds in order to minimize cost and maximize efficiency.

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