Comparative Summary of Optimal Use of Resources in Bakery and Feed Company by using Linear Programming.

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The maximum profit can be considered the primary goal of any for-profit organisation. To achieve the same, the right quantity of specific products need to be produced with respect to the available resources. To find the optimal solution, Linear programming can be, and has been, introduced. The businesses consider a certain number of variables and constraints in order to reach the best possible profit margin. In real life, the businesses and organisations may involve a large number of variables and constraints.

The concept of Linear programming is used and applied in the industries/fields of technology, manufacturing, city planning, mapping, telecommunication, transport, energy, agriculture and so on. However, in this study, we will focus on the business applications of this method.

In the business/financial applications, Linear programming assists in the optimal allocation of available resources, in order to get the maximum profit. The manager or the decision-maker of the organisation can increase the quality of their decisions by implementing Linear programming. High quality decisions will guide the whole organisation towards higher profits. Also, a hidden feature of Linear programming in business can be the reduction of wastage of resources (raw materials or time).

One of the many methods to solve Linear Programming Problems is the Simplex method. This method was created by George Dantzig during the World War II. However, it was an evolutionary process to develop this method, so it needed about a year to be perfected. In order the solve a Linear programming problem, the Simplex method instructs that the decision variables and constraints are to be in the standardized form.

Abstract.

In this paper, we will perform a comparative study between two papers which emphasize on two distinct applications of Linear Programming, namely;

Paper 1) Application of Linear Programming for Optimal Use of Raw Materials in Bakery.

Paper 2) Application of Linear Programming in a Manufacturing Company in Feed Masters, Kulende, Kwara State.

The summary and conclusion of each paper will be depicted. Also, the resemblances and variations among both researches will be illustrated.

Summary of Paper 1.

This paper is titled 'Application of Linear Programming for Optimal Use of Raw Materials in Bakery'. The study revolves around the task of allocating resources to obtain maximum profit, in the Goretta Bakery. The bakery produces three products which are, small load, big loaf and giant loaf. Simplex method was performed to solve the Linear programming problem. While using the Simplex method in this case, the decision variables are the three products produced by the Goretta Bakery (small loaf, big loaf and giant loaf). The raw materials (constraints) used are flour, sugar, yeast, salt, wheat gluten and soyabean oil.

Conclusion of Paper 1.

The authors of Paper 1 were successful to find the optimal number of finished goods to be made. The optimal number of loafs to be produced were as follows:

Small loaf - 962 units.

Big loaf - 38 units.

Giant loaf - 0 units.

Hence, in order to achieve maximum profit, the authors note that more of small loaf and big loaf, and less of giant loaf, are to be produced.

Summary of Paper 2.

This paper is titled ‘Application of Linear Programming in a Manufacturing Company in Feed Masters, Kulende, Kwara State’. The authors of this paper research on deriving the maximum profit from the production of feeds by a company named Feeds Masters Limited. The raw materials involved in this research are maize, G.N.C, soya beans, lime stone, bone, wheat offal, maize offal, fish offal, lysine, methionine, salt, layer premix, broiler premix and chick premix. The finished five products to be made are chick mash, layer mash, grower mash, broiler starter mash and broiler finisher mash. The Linear Programming Problem is solved by using Simplex method. The authors mention that this method searches around the feasible solutions while the objective function keeps on getting better.

Conclusion of Paper 2.

The authors conclude that out of five, only three products should be made in order to achieve maximum profit. These three products are 25kg of layers mash, 25kg of grower mash and 25kg of broiler finisher mash. The production quantities are as follows;

25kg of layers mash - 182 units

25kg of grower mash - 1000 units

25kg of broiler finisher mash - 1000 units

25kg of chick mash - 0 units

25kg of broiler starter mash - 0 units

Manufacturing products as per the mentioned quantities will produce the maximum profit of ₦668,367. 25kg of chick mash and 25kg of broiler starter mash are the two products whose production can be skipped to reach maximum profit.

Resemblance in Researches.

The research conducted by the authors of both the papers indicate the efforts to solve the Linear programming problem. A Linear programming problem is an optimization problem where the goal is the find maximum profit and minimum resource use. By using Linear programming methods, it is possible to find an optimal solution, while keeping the costs low. These said methods are used to allocate available resources (which are usually scarce) to find the best solution.

In both the papers, the use of Simplex method to solve the Linear programming problem can be seen.

And in the end, the authors of both the papers managed to allocate the limited resources to the products to be made and achieved the optimal/maximum profit for the respective businesses.

Method to solve LPP

The two papers use the Simplex Method to solve the Linear programming problem. The Simple Method was evolutionarily developed by George Dantzig, which has a function and many constraints which are expressed as inequalities.

Allocation of Resources

Both of the papers have the need for allocation of n resources in order to reach the maximum profit.

The authors of Paper 1 have allocated all the available raw materials to 2 out of 3 products, for the bakery to have maximum profit.

The authors of Paper 2 have allocated all the available raw materials to 3 out of 5 products, for the Feed manufacturing company to have maximum profit.

Model Formulation

In both the papers, we can see similarities in the formulation of models. Where the objective is to maximize 'Z'.

The model formulation for Paper 1:

$$\text{Max } Z = 30x_1 + 40x_2 + 20x_3$$

$$S.t$$

$$0.20x_1 + 0.24x_2 + 0.14x_3 \leq 200$$

$$0.14x_1 + 0.20x_2 + 0.16x_3 \leq 160$$

$$0.02x_1 + 0.02x_2 + 0.02x_3 \leq 20$$

$$0.0011x_1 + 0.00105x_2 + 0.00017x_3 \leq 8.5$$

$$0.000167x_1 + 0.002x_2 + 0.00012x_3 \leq 15$$

$$0.015x_1 + 0.021x_2 + 0.0098x_3 \leq 10$$

$$x_1, x_2, x_3 \geq 0$$

Where,

x1 = one unit of big loaf

x2 = one unit of giant loaf

x3 = one unit of small loaf

(Akpan, N. P.& Iwok, I.A. (2016). Application of Linear Programming for Optimal Use of Raw Materials in Bakery)

The model formulation for Paper 2:

$$Maximize\ Z = 333.45X_1 + 301.12X_2 + 302.37X_3 + 207.65X_4 + 311.25X_5$$

$$Subject\ to$$

$$11X_1 + 11X_2 + 8X_3 + 11X_4 + 10X_5 \le 20000$$
$$3X_1 + 3X_2 + 2X_3 + 5X_4 + 3.5X_5 \le 15000$$
$$4.5X_1 + 3X_2 + 8X_3 + 5X_4 + 4.5X_5 \le 25000$$
$$2X_1 + 0.5X_5 \le 10000$$
$$X_1 + 0.5X_2 + 0.5X_3 + 1.5X_4 + 0.5X_5 \le 14000$$
$$5X_1 + 6.5X_2 + 4X_3 + 1.6X_4 + 5X_5 \le 15500$$
$$2.5X_3 \le 15000$$
$$0.5X_1 + 0.5X_2 + X_4 + X_5 \le 8000$$
$$0.05X_1 + 0.05X_2 + 0.05X_3 + 0.03X_4 + 0.03X_5 \le 1000$$
$$0.05X_1 + 0.05X_2 + 0.05X_3 + 0.03X_4 + 0.03X_5 \le 1000$$
$$0.07X_1 + 0.075X_2 + 0.075X_3 + 0.07X_4 + 0.07X_5 \le 8000$$
$$0.075X_2 \le 2000$$
$$0.07X_4 + 0.07X_5 \le 75$$
$$0.07X_4 + 0.075X_5 \le 75$$
$$For\ X_i \ge 0, i = 1, 2, 3, ..., 5$$

Where,

X1 = 25kg of Chick mash

X2 = 25kg of Layers mash

X3 = 25kg of Growers mash

X4 = 25kg of Broiler starter mash

X5 = 25kg of Broiler finisher mash

(Balogun.O.S., Role.M.R., Akingbade.T.J. and Akinrefon.A.A.(2013). Application Of Linear Programming In A Manufacturing Company In Feed Masters, Kulende, Kwara State)

Optimal Solution

The optimal solution found out by the authors of Paper 1 was;

Small loaf - 962 units.

Big loaf - 38 units.

Giant loaf - 0 units.

And, the optimal solution produced by the authors of Paper 2 was;

25kg of layers mash - 182 units

25kg of grower mash - 1000 units

25kg of broiler finisher mash - 1000 units

25kg of chick mash - 0 units

25kg of broiler starter mash - 0 units

Maximum Profit

Authors of both papers produced the maximum profit. The maximum profit for the bakery in Paper 1 was ₦20,385. And, in Paper 2, it was ₦668,367 for the Feed Master Limited.

Variation in Researches.

Decision Variables Count

In Paper1, there are a total of three decision variables namely; big loaf, giant loaf and small loaf. In Paper 2, there are five decision variables namely; chick mash, layers mash, growers mash, broiler starter mash and broiler finisher mash (25kg of each).

Constraints Count

In Paper 1, there are six constraints with their respective availability. In Paper 2, there are a total of fourteen constraints with their respective availability.

Decision Variable Units

In Paper 1, the decision variables, i.e. small loaf, big loaf and giant loaf, were considered as one unit of itself.

Whereas, in Paper 2, one unit of a decision variable was considered as 25kgs of itself.

Raw Materials and Final Products

In Paper 1, there were six raw materials and three final products involved, for the Goretta Bakery. Paper 2 had fourteen raw materials and five final products for the feed manufacturing company.

Software

The software used to solve the Linear programming problem in Paper 1 was TORA software, Version 2.0. In Paper 2, the software used to solve the same was The Management Scientist, Version 6.

Conclusion

The authors of both the papers have accomplished the implementation of Linear programming to solve the optimization problem in two different businesses. In each research, the Simplex method was used to allocate the resources. We observed similarities in the model formation, resource allocation technique and LP method used. Both the researches resulted in the optimal allocation of available resources and finding the maximum profit. We also noted a few differences which involved the number of decision variable and constraints, units used for decision variable, raw materials & final product and the software used for computation.

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