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Linear Programming on Bread Production Using Uncertainty Approach

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Abstract

Linear programming is applied to bread production and the raw materials for the research were collected from the bakery industry in Lokoja which were clearly identified. The paper took into account three types of bread with estimated profits and the problem was formulated from the collected data. The formulated problem was parameterized into parametric linear programming and run using the developed algorithm of linear programming The result obtained indicates that profit is made at d different values of the parameter ,t, leaving the company the choice of any profit it wants to get.

Keywords: Linear programming; Optimize; Parameter; Objective function; Limitations; Estimate and interval.

1. Introduction

A new war-related projects demand attention and spread resources all over the glove. Many theorems have been developed in linear programming and explored their applications in recent times. Linear programming model is one of the best technique of managing scare resources for optimal production globally, particularly during high cost of production, economic crisis and srecession [1, 2]. A company‘s endurance in the competitive market closely depends on its stability to produce the highest quality products at the lowest possible cost [3]. There is no doubt that there are limited resources at the disposal of every organization and as a result of this, managers are forced with decision to choose the best means of managing the scare resources using linear programming in order to maximize profit [4].

In recent time, manufacturing industries at all levels are faced with the challenges of producing goods of right quality and quantity on time and more especially at minimum cost and maximum profit for the survival and growth. Thus, this demands for an increase in production efficiency of the industry [5]. In today business competition is getting tighter and harder, with more and more companies growing. This condition causes many companies to be at their forefront of their fields. In reality every company must be able to develop and improve performance to achieve effectiveness and efficiency. With this new ideas are needed to bring the business world into a more advanced direction so that it can keep up with the increasingly tight competition [6-9].

2. Methodology

The use of linear programming tools and MATLAB algorithm to obtain optimal cutting plane, They employed the use of two software tools to solve Mathematical program for optimization of sheet metal cutting plane. Isah, *et al.* [9]; Junaid and Mukhtar [10] focused on linear programming for achieving production mixed optimization in terms of the product identification and the right quality in paint production for better profit and optimum firm performance.

3. Data Collection and Formulation

The data used for this work were collected from Ostrich Bakery Lokoja and the amount of raw materials are; sugar, flour, yeast coconut-flavour, pineapple flavour and soybean-oil for daily production of the three different type of bread (pineapple, coconut and butter bread) and the profit per each type of the bread produced depended on the availability of the raw material and the required flour. The quality of flour available is 200kg each unit of coconut bread requires 0.2kg of flour , each unit of pineapple bread requires 0.24kg of flour and each unit of butter bread requires 0.14kg of sugar.

Total amount of sugar available is 150g, each unit of coconut bread requires 0.14kg of sugar 0.14g of sugar, each unit of pineapple bread requires 0.2g of sugar and each unit of butter bread requires 0.1g of sugar.

3.1. Yeast Available for Production

The total amount of yeast available is 20kg, each unit of coconut bread requires 0.02kg of yeast, each unit of of pineapple bread requires 0.02kg of yeast and each unit of butter bread requires 0.02kg of yeast.

3.2. Salt Available for Production

The total amount of salt available is 18kg. Each unit of coconut bread requires 0.0011g of salt, each unit of pineapple bread requires 0.0105g of salt and each unit of butter bread requires 0.00017g of salt.

3.3. Soy-Bean-Oil Available for Production

The total amount of soy-bean-oil available is 10.01g. Each unit of coconut bread requires 0.0157g of soy-bean oil, each unit of pineapple requires 0.021g of soy-bean oil and each unit of butter bread requires 0.00981g of soy-bean oil.

3.4. Coconut Flavour Available for Production

The total amount of coconut flavour available is 20g. Each unit of coconut bread requires 0.0g of coconut flavour, each unit of pineapple bread requires 0g of coconut flavour and each unit of butter bread requires 0g of coconut flavour.

3.5. Pineapple Flavour Available for Production

The total amount of pineapple flavour available is 20g. Each unit of coconut bread requires 0g of pineapple flavour, each unit of pineapple bread requires 0.02g of pineapple flavour and each unit of butter bread requires 0g of pineapple flavour.

3.6. Butter Flavour Available for Production

The total amount of butter flavour available is 200kg. Each unit of coconut bread requires 0.001kg of butter flavour, each unit of pineapple bread requires 0.001kg of butter flavour and each unit of butter bread requires 0.09kg of butter flavour.

Profit per unit type of bread produced is as follows: each unit of coconut bread made a profit of ₦25-₦30, each unit of pineapple bread made a profit of ₦30-₦35 and each unit of butter bread made a profit of ₦15-₦20.

Table-1. Production requirements

Raw Material	Coconut bread/g	Pineapple bread/g	Butter Bread/g	Total availability of raw material
Flaour	0.2	0.24	0.14	200
Sugar	0.14	0.2	0.16	150
Yeast	0.02	0.02	0.02	20
Salt	0.0011	0.00105	0.00017	18.5
Soybean oil	0.0157	0.021	0.0098	10
Coconut flavour	0.02	0	0	20
Pineapple flavour	0	0.02	0	20
Butter	0.001	0.001	0.09	50

3.7. Problem Formulation

Let x_1 be the quantity of coconut bread to be produced.

x_2 be the quantity of pineapple bread to be produced.

x_3 be the quantity of butter bread to be produced.

So the parametric linear programming is as below:

As the formulated problem has uncertainty (estimates) components in the objective function, it has to be parameterized and generates solutions from the specified values of the parameter, t, within a closed interval.

$$MaxZ = (30+5t)x_1 + (35+3t)x_2 + (20+4t)x_3$$

$$\begin{aligned}
&0.2x_1 + 0.24x_2 + 0.14x_3 \le 200\\
&0.14x_1 + 0.2x_3 + 0.16x_3 \le 150\\
&0.2x_1 + 0.02x_2 + 0.02x_3 \le 20\\
&0.0011x_1 + 0.00105x_2 + 0.00017x_3 \le 18.5\\
&0.0157x_1 + 0.021x_2 + 0.0098x_3 \le 10\\
\text{s.t}\quad &0.02x_1 \le 20\\
&0.02x_2 \le 20\\
&0.0011x_1 + 0.001x_2 + 0.09x_3 \le 50\\
&x_1, x_{2,}, x_3 \ge 0
\end{aligned}$$

Table-2. Results of computation

t	x_1	x_2	x_3	Value Z(₦)
0	335.57	0	551.827	21103.658
0.1	335.57	0	551.827	21547.355
0.2	335.57	0	551.827	21991.055
0.3	335.57	0	551.827	22434.754
0.4	335.57	0	551.827	22878.451
0.5	335.57	0	551.827	23322.150
0.6	335.57	0	551.827	23765.848
0.7	335.57	0	551.827	24209.547
0.8	335.57	0	551.827	24653.246
0.9	335.57	0	551.827	25096.945
1	335.57	0	551.827	25540.645

4. Result and Analysis

The results obtained in table 2 of results of computation showed that Coconut bread (x_1) will. be 336 units, pineapple bread (x_2) will not be produced and butter bread (x_3) will produced 552 units to make the profit of ₦21103.658 to ₦25540.645 depending on the value of the parameter , t. The results give the decision maker (the manager) the opportunity to choice the values of t that will him the desire results within the uncertainty. The estimated parameter (t) covers all the unknown circumstances that may arise during or after production. This means the production of pineapple bread has no effect on the profit the bakery.

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