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Applying Linear Programming For Preparation Of Sugar Free Atta Cookies For Profit Maximization

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Abstract:

This study explores the application of linear programming techniques in the formulation of sugar-free atta cookies, optimizing ingredients to meet specific nutritional criteria. By formulating a mathematical model, the study aims to achieve to earn maximum profit in minimum investment also balance between taste, texture, and health benefits, ensuring the production of cookies that are both delicious and nutritionally beneficial. Linear programming can apply to real-life problems. We will use simplex methods for solving the model by Excel. The aim of the present work is to use the simplex algorithm of linear programming to find the maximum profit in the selling of Bakery item such as sugar free Atta Cookies.

Keywords: Linear programming model, Simplex method, Decision variables, Optimal result, Excel

I. Introduction

OR is Basically is a Branch of Mathematics which provides a Solid Base to Management to take early and Effective Decision for any Organization Specially Applied in Mathematics application to provide a Scientific Base for Management to take timely and effective decisions to their Problems. The scope of Operations Research is wide and has been successfully applied in the following areas such as Industry, Defense, Planning, Agriculture and Public Utilities. Linear Programming is an approach in mathematics is widely used today the Programming Concept is use full to Allocate the Resources in a Proper way. 'Programming' means taking decisions systematically. The Necessity of the work to use linear programming model determine the maximum profit while minimizing the cost.

In previous studies, researchers have applied linear programming techniques to optimize various production processes and maximize profits. For instance, Anieting et al. (2013) used linear programming to determine the optimal production levels for Usmer Water Company, while Akpan et al. (2016) utilized the simplex algorithm within linear programming to allocate raw materials effectively in a bakery for profit maximization. Similarly, Raimi et al. (2017) applied linear programming to optimize bread production at Rufus Giwa Polytechnic Bakery, considering different types of bread.

Linear programming models, as highlighted by Waheed et al. (2012), are commonly employed in operations research and management sciences to address resource allocation issues. They demonstrated this by optimizing profit in a company producing medicated soap, showing that focusing on specific product units could lead to the highest profit margins.

In our current study, we employ a linear programming model to optimize the production of sugar-free atta cookies, aiming to achieve maximum profitability.

II. General Form of a Linear Programming Model

The general Linear Programming model with n decision variables and m constraints can be expressed as follows.

Optimize (*Maximize or Minimize*)

$$z = p_1x_1 + p_2x_2 + \ldots + p_nx_n \text{ (objective function)} \qquad \ldots..(1.1)$$

subject to the set of constraints

$$\left.\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n (\le, =, \ge) b_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n (\le, =, \ge) b_2 \\ \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \\ \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n (\le, =, \ge) b_m \end{array}\right\} \qquad \ldots..(1.2)$$

and non-negative restrictions

$$x_j \ge 0, \qquad j = 1, 2 \ldots n$$

where a_{ij}'s, b_i's and c_j's are constants and x_j's are variables.
In the conditions given by (1.2) there may be any of the three signs $\le, =, \ge$.
Standard form of a Linear programming problem for solving by simplex method is as

(a) Using slack variable for each inequity constraint $\le$ and surplus variables each inequity constraint $\ge$.
(b) For each constraints all $b_i \ge 0$, if any b_i is negative then multiply the corresponding constraint by – 1.
(c) If the problem is not already in maximization form, multiply the objective function by -1 to convert it to maximization form.

Using slack and surplus variables the linear programming problem of n variables and m constraints can be written as follows:

Optimize

$$z = p_1x_1 + p_2x_2 + \ldots + p_nc_n + 0.s_1 + 0.s_2 + \ldots + 0.s_m \text{ (Objective Function)} \qquad \ldots(1.3)$$

subject to the constraints

$$\left.\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n + s_1 = b_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n + s_2 = b_2 \\ \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \\ \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n + s_m = b_m \end{array}\right\} \qquad \ldots(1.4)$$

and non-negative restrictions

$$x_j \ge 0, \; s_i \ge 0, \; j = 1, 2 \ldots n, i = 1, 2 \ldots m$$

where a_{ij}'s, b_i's and c_j's are constants and x_j's and s_i's are variables.

III ASSUMPTIONS

- We presume that the necessary ingredients for making sugar-free atta cookies are readily available.
- We assumed that an efficient allocation of Ingredients to the variables of sugar free atta cookies will aid optimal production and at the same time maximizing the profit in minimum investment.
- We assumed that the qualities of Ingredients used in sugar free atta cookies production are standard.

The above data can be abstract in a tabulerize figure.

Ingredients	Product			Total Present Ingredients
	Large packet Atta cookies (x1)	Medium packet Atta cookies(x2)	Small packet Atta cookies (x3)	
Coconut powder (kg)	0.49	0.30	0.25	150
Butter(L)	0.20	0.15	0.012	120 L
Cardamon (g)	0.00625	0.006	0.00063	50
Semolina (kg)	0.00625	0.006	0.00063	120
Atta (kg)	0.00625	0.005	0.00063	700
Dry fruit (kg)	0.00313	0.003	0.00032	130
Milk(ml)	0.008	0.004	0.001	1500
Jaggery Power(g)	0.006	0.004	0.001	4000
Profit(Rs)	56	45	60	

IV. MODEL FORMULATION

Let the amount of Large packet Atta cookies to be manufacture = x_1
Let the amount of Medium packet Atta cookies to be manufacture = x_2
Let the amount of Small packet Atta cookies to be manufacture = x_3

Let Z mean the profit to be increased
The L.P model for the above composition data is stated by

MAX $Z = 56x_1 + 45x_2 + 60x_3$

Subject to

$0.49x_1 + 0.30x_2 + 0.25x_3 \leq 150$

$0.20x_1 + 0.15x_2 + 0.012x_3 \leq 120$

$0.00625x_1 + 0.006x_2 + 0.00063x_3 \leq 50$

$0.00625x_1 + 0.004x_2 + 0.00063x_3 \leq 120$

$0.00625x_1 + 0.005x_2 + 0.00063x_3 \leq 700$

$0.00313x_1 + 0.003x_2 + 0.00032x_3 \leq 130$

$$0.008x_1 + 0.004x_2 + 0.001x_3 \leq 1500$$

$$0.006x_1 + 0.004x_2 + 0.001x_3 \leq 4000$$

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

The above linear programming model was solved by EXCEL, which gives an optimal solution of: $x_1 = 0$, $x2= 0$, $x3= 600$ and maximum **Z = 36000.**

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V. Interpretation of Result

According to the analysis of the gathered data, the most favorable outcome from the model suggests that manufacturing small packets of sugar-free Atta cookies is the optimal choice. The recommended production quantities for each type of cookie are 600 units. This production plan is expected to yield a maximum profit of Rs36000.

VI. Summary

The objective of this study was to utilize linear programming (LP) techniques to optimize the utilization of ingredients in the production of sugar-free Atta cookies. The investigation centered around Ganpati Bakery and Sneh Kirana Store as the case study. The decision variables in this research were the three different packaging sizes of Atta cookies manufactured by Ganpati Bakery. The study primarily concentrated on eight ingredients (Coconut powder, Butter, Cardamom, Semolina, Atta, Dry fruit, Milk, and Jaggery Powder) used in production, along with the required amounts of each ingredient for the various types of Atta cookies. The findings indicate that producing 600 units of small-sized sugar-free Atta cookies would result in a maximum profit of Rs 36,000.

VII. Conclusion

In light of the examination did in this investigation work and the outcome appeared, Ganpati bakery and sneh Kirana Store should create the three sizes sugar free Atta cookies with the end goal to fulfill clients. Additionally, a greater amount of small packets of sugar free Atta cookies ought to be created with the end goal to achieve most extreme benefit, since they contribute for the most part to the benefit earned by the shopkeeper. Sugar-free atta cookies offer a health-conscious alternative, providing guilt-free indulgence. Rich in fiber and nutrients, they support better blood sugar control and promote overall wellness. With their delicious taste and nutritional benefits, these cookies prove that health-conscious choices can be both satisfying and enjoyable.

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