Tcomparison Of Profit Optimization Using Linear Programmming and Cutting Plane Methods (Case Study : Home Industry Potatora Bakery)

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Abstract—This study aims to compare the profit optimization of bread production in Home Industry Potatora Bakery by forming a linear program whose function is to maximize the profit of bread production and the constraint function in the form of raw material for bread products in 45 gram packaging and bread production time. The data used is data on bread production at Home Industry Potatora Bakery in 2022. The methods used in this study are Linear Programming and Cutting Plane methods. The results of the optimization calculation using the linear programming method, namely the maximum profit in a day is Rp. 557,188.5 in the production of 2 types of bread, which include 337 packs of Boi Chocolate Bread and 143.75 Streussel Strawberry Bread. As for the results of optimization calculations using the cutting method, namely the maximum profit of Rp. 557,870 in the production of 2 types of bread, which includes 338 packs of Boi Chocolate Bread and 144 Streussel Strawberry Breads. Based on the calculation results, it can be said that the benefits obtained by using the plane cutting method are more leverage than the linear programming method.

Keywords—Linear Programming; Optimization;Profit;Production; Linear Programming Method; Cutting Plane Method

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I. INTRODUCTION

The bread industry is part of the ready-to-eat food industry by utilizing wheat flour as the main ingredient in its production process. In Indonesia, there are many small bakery industries that are still growing despite the economic crisis. Small bread industry is around 60%, large industry is around 20% and the rest is medium industry. Seeing the rapid development of the bread industry, product innovation is needed as a business improvement [1]. One of them is making bread products with various variations. Currently, in Blitar City, there are many home bakery industries. One of them Home Industry Potatora Bakery.

Potatora Bakery is one of the businesses engaged in the food industry in making bread. This company was founded in 2016 with its address at Jalan Beliton Barat No.36 B Karangtengah, Blitar City. The Potatora Bakery company produces various types of bread, namely Boi Chocolate Bread, Cheese Butter Bread, Chocolate Banana Bread, Chocolate Peanut Bread, Strawberry Streusel Bread, Blueberry Streusel Bread, Shredded Bread, and Flower Bread. Based on the results of observations, it was found that the number of requests for bread production was uncertain every day and for the purchase of raw materials, it was still using the forecast method. Therefore potatora bakery requires planning the optimal amount of production to get maximum profit by determining the number of products that will be produced every day. So that it can meet the number of requests by considering the production costs incurred. In mathematics this problem is known as optimization.

Optimization is the achievement of the best state or condition, meaning the achievement of problem solutions aimed at the maximum and minimum limits. Optimization problems include minimizing production costs or maximizing profits so as to get optimal results [2] (Karo, 2018). In overcoming the problem of determining the amount of production, it is necessary to optimize using linear programming and cutting planes.

Linear programming is a mathematical method in the form of linear to determine an optimal solution by maximizing or minimizing the objective function against a constraint [3] (Siswanto, 2018). Cutting plane is a method used to solve linear programming cases in the form of non-integer numbers with the addition of new constraints (gomory). The addition of new constraints is done if the value of the decision variable is not unanimous [4](Nico, 2017).

Research using linear programming and cutting plane methods refers to previous studies. in optimizing the production of the furniture angga business [5]. The results of the research show that the maximum profit can be determined using the linear programming method [5]. Secondly, by Fatimah et al (2021) in optimizing tofu production using the cutting plane method, it shows that the maximum profit can be determined by the cutting plane method [6].

Based on previous research, the variables used were at most 6 variables, so in this study the researchers developed by adding 2 variables to 8 variables and using different subjects and had never been studied before, namely Home Industry Potatora Bakery.

II. RESEARCH METHOD

The data used in this optimization is bread production data in 2022 at Home Industry Potatora Bakery. The data in this optimization is primary data. Primary data is data that comes from the original or first source. This data is not available in compiled form or in file form. This data must be sought through sources, namely people who are used as objects of research or as a means of obtaining data (Wardiyanta, 2017) [8]. The data obtained was then validated by the owner of Home Industry Potatora Bakery. This optimization uses numbers (numbers), from the beginning of data collection, data analysis, to the optimization results obtained, so the research approach in optimization is called the quantitative research approach. The research method in completing this optimization is the Linear Programming and Cutting Plane method.

The following are the stages of linear programming and cutting plane methods in solving optimization problems:

1. Forming decision variables, namely variables related to decisions used in optimization problems.
2. Forming the objective function, namely the function on the decision variable that is maximized or minimized
3. Establish limiting function/constraint, which is a function of the barrier/constraint faced by the company, so that the value (coefficient) of the decision variable cannot be determined arbitrarily.
4. Forming a mathematical model of a linear program, namely the mathematical method used in allocating resources (needs) that have limits/constraints in achieving the goal, namely maximizing profits or minimizing costs.
5. Solve optimization problems using the linear programming method with the following steps:
    a. The objective and constraint functions that have been converted into standard form are arranged in the initial simplex table.
    b. Specifying the entering variable or key column.
    c. Specifies the leaving variable or key row.

d. Change the values of the leaving variable or row key.

e. Performs elementary row operations.

f. Perform steps b to step e so that the optimum value is obtained in the row.

6. Solve optimization problems using the cutting plane method with the following steps:
   a. Solve integer programming problems using the simplex method.
   b. Check the optimum solution. If all the base variables have integer values, the integer optimum solution has been obtained and the solution process has ended. If one or more of the base variables have a fractional value, then go to step
   c. If the completion of step 1 contains a decision variable that has a fractional value then do the following steps.
7. Taking conclusions obtained from the results of research problems.

III. RESULT AND DISCUSSION

A. Linear Program Mathematical Model

a) Shaping Decision Variables

The decision variables in this optimization are 8 types of bread produced at Home Industry Potatora Bakery in 2022, namely Boi Chocolate Bread (x_1), Cheese Butter Bread (x_2), Chocolate Banana Bread (x_3), Chocolate Peanut Bread (x_4), Bread Strawberry Streusel (x_5), Blueberry Streusel Bread (x_6), Shredded Bread (x_7), and Flower Bread (x_8).

b) Establishing the Objective Function

The objective function in this optimization is the profit of bread production in 45 gram packages, these advantages can be presented in table 1 below:

Table 1. Advantages of Bread Production in 45 Gram Packages

Jenis Produk Roti	Rata-Rata Harga Jual Produk (Rp)	Rata-Rata Biaya Produksi (Rp)	Keuntungan Produksi Roti (Rp)
Boi Coklat	3.000	1.775	1.225
Butter Keju	3.000	1.900	1.100
Pisang Coklat	3.000	2.000	1.000
Coklat Kacang	3.000	1.850	1.150
Streusel Strawberry	3.000	2.000	1.000
Streusel Blueberry	3.000	2.000	1.000
Abon	3.000	1.850	1.150
Bunga	3.000	1.800	1.200

So, based on table 1, there are advantages of bread production of 8 types of bread that can be formed by the objective function in equation (3) below:

$$f(x) = 1.225x_1 + 1.100x_2 + 1.000x_3 + 1.150x_4 + 1.000x_5 + 1.150x_6 + 1.000x_7 + 1.200x_8 \quad (3)$$

c) **Establishing a Constraint Function**

The limiting function or constraint in this optimization is the raw material for each type of bread product in 45 gram packages and the production time of bread per package, these constraints can be presented in table 2 and table 3, as follows:

Table 2. Raw materials for each type of bakery product in 45 gram packages

Bahan Baku	Jenis Produk Roti (Gram)								Persediaan Bahan (Gram)
	Boi	Butter Keju	Pisang Coklat	Coklat Kacang	Streussel Strawberry	Streussel Blueberry	Abon	Bunga	
Tepung	6	5	5	3	4	3	3	7	18000
Gula	1,8	1,7	1,7	1,7	1,6	1,6	1,8	1,9	14500
Telur	4	5	5	5	4	4	5	6	12500
Susu Bubuk	2	3	2	2	4	4	2	4	1250
Mentega	4,5	6	5	5	4,5	4,5	5	6	5000
Pengembang	0,5	0,5	0,25	0,5	0,7	0,7	0,25	0,25	525
Pelembut	1,5	2	2	1,5	1	1	2,5	2	650
Toping	4	5	3	5	3	3	4	2	3700

Table 3. Bread Production Time

Jenis Produk	Waktu (Menit)
Roti Boi	1,23
Butter Keju	1,25
Pisang Coklat	1,25
Coklat Kacang	1,32
Streussel Strawberry	1,25
Streussel Blueberry	1,25
Abon	1,35
Bunga	1,23

Based on table 2 and table 3, there are 9 constraints in bread production, so that the constraint function can be formed in equation 4 below:

$$
\begin{aligned}
&6x_1 + 5x_2 + 5x_3 + 3x_4 + 4x_5 + 3x_6 + 3x_7 + 7x_8 \le 18000\\
&1{,}8x_1 + 1{,}7x_2 + 1{,}7x_3 + 1{,}7x_4 + 1{,}6x_5 + 1{,}6x_6 + 1{,}8x_7 + 1{,}9x_8 \le 14500\\
&4x_1 + 5x_2 + 5x_3 + 5x_4 + 4x_5 + 4x_6 + 5x_7 + 6x_8 \le 12500\\
&2x_1 + 3x_2 + 2x_3 + 2x_4 + 4x_5 + 4x_6 + 2x_7 + 4x_8 \le 1250\\
&4{,}5x_1 + 6x_2 + 5x_3 + 5x_4 + 4{,}5x_5 + 4{,}5x_6 + 5x_7 + 6x_8 \le 5000 \qquad (4)\\
&0{,}5x_1 + 0{,}5x_2 + 0{,}25x_3 + 0{,}5x_4 + 0{,}7x_5 + 0{,}7x_6 + 0{,}25x_7 + 0{,}25x_8 \le 525\\
&1{,}5x_1 + 2x_2 + 2x_3 + 1{,}5x_4 + 1x_5 + 1x_6 + 2{,}5x_7 + 2x_8 \le 650\\
&4x_1 + 5x_2 + 3x_3 + 5x_4 + 3x_5 + 3x_6 + 4x_7 + 2x_8 \le 3700\\
&1{,}23x_1 + 1{,}25x_2 + 1{,}25x_3 + 1{,}32x_4 + 1{,}25x_5 + 1{,}25x_6 + 1{,}35x_7 + 1{,}23x_8 \le 675
\end{aligned}
$$

d) **Forming a Linear Program**

Based on equations (3) and (4), a linear program can be formed, so that the following equation (5) is obtained:

$$Maks\ z = f(x) = 1.225x_1 + 1.100x_2 + 1.000x_3 + 1.150x_4 + 1.000x_5 + 1.000x_6 + 1.150x_7 + 1.200x_8$$

$$\text{kendala } (g_i(x)) : g_1 = 6x_1 + 5x_2 + 5x_3 + 3x_4 + 4x_5 + 3x_6 + 3x_7 + 7x_8 \leq 18000$$

$$g_2 = 1{,}8x_1 + 1{,}7x_2 + 1{,}7x_3 + 1{,}7x_4 + 1{,}6x_5 + 1{,}6x_6 + 1{,}8x_7 + 1{,}9x_8 \leq 14500$$

$$g_3 = 4x_1 + 5x_2 + 5x_3 + 5x_4 + 4x_5 + 4x_6 + 5x_7 + 6x_8 \leq 12500$$

$$g_4 = 2x_1 + 3x_2 + 2x_3 + 2x_4 + 4x_5 + 4x_6 + 2x_7 + 4x_8 \leq 1250$$

$$g_5 = 4{,}5x_1 + 6x_2 + 5x_3 + 5x_4 + 4{,}5x_5 + 4{,}5x_6 + 5x_7 + 6x_8 \leq 5000$$

$$g_6 = 0{,}5x_1 + 0{,}5x_2 + 0{,}25x_3 + 0{,}5x_4 + 0{,}7x_5 + 0{,}7x_6 + 0{,}25x_7 + 0{,}25x_8 \leq 525$$

$$g_7 = 1{,}5x_1 + 2x_2 + 2x_3 + 1{,}5x_4 + 1x_5 + 1x_6 + 2{,}5x_7 + 2x_8 \leq 650 \quad (5)$$

$$g_8 = 4x_1 + 5x_2 + 3x_3 + 5x_4 + 3x_5 + 3x_6 + 4x_7 + 2x_8 \leq 3700$$

$$g_9 = 1{,}23x_1 + 1{,}25x_2 + 1{,}25x_3 + 1{,}32x_4 + 1{,}25x_5 + 1{,}25x_6 + 1{,}35x_7 + 1{,}23x_8 \leq 675$$

$$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9 \geq 0$$

B. Completing the Optimization of Bread Production Profits Using the Linear Programming Method

a) **Converting Inequality Constraints in Linear Programs to Equation Constraints** Change the inequality in equation (5) into equation constraint by adding the slack variable so that it becomes equation (6) below:

$$Z = 1.250x_1 + 1.250x_2 + 1.000x_3 + 1.000x_4 + 1.100x_5 + 1.100x_6 + 1.200x_7 + 1.500x_8 + 0S_1 + 0S_2 + 0S_3 + 0S_4 + 0S_5 + 0S_6 + 0S_7 + 0S_8 + 0S_9$$

$$6x_1 + 5x_2 + 5x_3 + 3x_4 + 4x_5 + 3x_6 + 3x_7 + 7x_8 + S_1 = 18000$$

$$1{,}8x_1 + 1{,}7x_2 + 1{,}7x_3 + 1{,}7x_4 + 1{,}6x_5 + 1{,}6x_6 + 1{,}8x_7 + 1{,}9x_8 + S_2 = 14500$$

$$4x_1 + 5x_2 + 5x_3 + 5x_4 + 4x_5 + 4x_6 + 5x_7 + 6x_8 + S_3 = 12500$$

$$2x_1 + 3x_2 + 2x_3 + 2x_4 + 4x_5 + 4x_6 + 2x_7 + 4x_8 + S_4 = 1250$$

$$4{,}5x_1 + 6x_2 + 5x_3 + 5x_4 + 4{,}5x_5 + 4{,}5x_6 + 5x_7 + 6x_8 + S_5 = 5000 \quad (6)$$

$$0{,}5x_1 + 0{,}5x_2 + 0{,}25x_3 + 0{,}5x_4 + 0{,}7x_5 + 0{,}7x_6 + 0{,}25x_7 + 0{,}25x_8 + S_6 = 525$$

$$1{,}5x_1 + 2x_2 + 2x_3 + 1{,}5x_4 + 1x_5 + 1x_6 + 2{,}5x_7 + 2x_8 + S_7 = 650$$

$$4x_1 + 5x_2 + 3x_3 + 5x_4 + 3x_5 + 3x_6 + 4x_7 + 2x_8 + S_8 = 3700$$

$$1{,}23x_1 + 1{,}25x_2 + 1{,}25x_3 + 1{,}32x_4 + 1{,}25x_5 + 1{,}25x_6 + 1{,}35x_7 + 1{,}23x_8 + S_9 = 675$$

$$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_9 \geq 0$$

b) Inserting Objective Functions and Constraint Functions into the Simplex Table Based on equation (6), it can be entered into the following table 4 simplex:

Table 4. Initial Simplex

CI	CJ	1225	1100	1000	1150	1000	1000	1150	1200	0	0	0	0	0	0	0	0	0	
	VB	X1	X2	X3	X4	X5	X6	X7	X8	S1	S2	S3	S4	S5	S6	S7	S8	S9	NK
[redacted]																			
0	S1	6	5	5	3	4	3	3	7	1	0	0	0	0	0	0	0	0	18000
0	S2	1.8	1.7	1.7	1.7	1.6	1.6	1.8	1.9	0	1	0	0	0	0	0	0	0	14500
0	S3	4	5	5	5	4	4	5	6	0	0	1	0	0	0	0	0	0	12500
0	S4	2	3	2	2	4	4	2	4	0	0	0	1	0	0	0	0	0	1250
0	S5	4.5	6	5	5	4.5	4.5	5	6	0	0	0	0	1	0	0	0	0	5000
0	S6	0.5	0.5	0.25	0.5	0.7	0.7	0.25	0.25	0	0	0	0	0	1	0	0	0	525
0	S7	1.5	2	2	1.5	1	1	2.5	2	0	0	0	0	0	0	1	0	0	650
0	S8	4	5	3	5	3	3	4	2	0	0	0	0	0	0	0	1	0	3700
0	S9	1.23	1.25	1.25	1.32	1.25	1.25	1.35	1.23	0	0	0	0	0	0	0	0	1	675

c) Performing Elementary Row Operations

Based on table 4, iteration calculations are carried out so as to get the optimal solution results in the third iteration, presented in table 5 below:

Table 5. Optimal Solution of Simplex Method

CJ	CJ	1225	1100	1000	1150	1000	1000	1150	1200	0	0	0	0	0	0	0	0	0	
	VB	X1	X2	X3	X4	X5	X6	X7	X8	S1	S2	S3	S4	S5	S6	S7	S8	S9	NK
ITERASI 3																			
0	S1	0	-3	-3	-3	0	-1	-7	-1	1	0	0	0	0	0	-4	0	0	15400
0	S2	0	-0.75	-0.6	-0.1	0	0	-1	-0.7	0	1	0	-0.15	0	0	-1	0	0	13662.5
0	S3	0	-0.5	0	1	0	0	-1	0	0	0	1	-0.5	0	0	-2	0	0	10575
1000	X5	0	0.125	-0.25	0	1	1	-0.5	0.5	0	0	0	0.375	0	0	-0.5	0	0	143.75
0	S5	0	-0.1875	-0.625	0.5	0	0	-1.75	-0.75	0	0	0	-0.5625	1	0	-2.25	0	0	2834.375
0	S6	0	-0.2125	-0.325	0	0	0	-0.4	-0.6	0	0	0	-0.1375	0	1	-0.15	0	0	255.625
1225	X1	1	1.25	1.5	1	0	0	2	1	0	0	0	-0.25	0	0	1	0	0	337
0	S8	0	-0.375	-2.25	1	0	0	-2.5	-3.5	0	0	0	-0.125	0	0	-2.5	1	0	1918.75
0	S9	0	-0.44375	-0.2825	0.09	0	0	-0.485	-0.625	0	0	0	-0.16125	0	0	-0.605	0	1	80.1875
	ZJ	1225	1656.25	1587.5	1225	1000	1000	1950	1725	0	0	0	68.75	0	0	725	0	0	557187.5
	CJ-ZJ	0	-556.25	-587.5	-75	0	0	-800	-525	0	0	0	-68.75	0	0	-725	0	0	

In table 5, the value of = 557,188.5 is obtained and the table above shows the value of < 0 which means that the optimal solution has been obtained with the optimal solution value, namely X_1 = 337 and X_5 = 143.75. After three iterations, the optimal solution is obtained.

C. **Completing the Optimization of Bread Production Profits Using the Cutting Plane Method**

a) **Solving integer problems using the simplex method**

Based on table (5), the optimal solution of the simplex method is obtained with a value of = 557,188.5 with a value of 5 = 143.75. Because there are still non-integer decision variables, it is continued with the cutting plane method with the addition of new constraints to produce a solution in the form of an integer number.

b) **Adding the formed Gomory Piece to the last row in the table**

After obtaining new constraints and adding Gomory constraints, then adding the Gomory pieces that have been formed to the last row in Table 6 below

Table 5. Table After Adding Gomory Pieces

CJ	CJ	1225	1100	1000	1150	1000	1000	1150	1200	0	0	0	0	0	0	0	0	0		
	VB	X1	X2	X3	X4	X5	X6	X7	X8	S1	S2	S3	S4	S5	S6	S7	S8	S9	Sg1	NK
0	S1	0	-3	-3	-3	0	-1	-7	-1	1	0	0	0	0	0	-4	0	0	0	15400
0	S2	0	-0.75	-0.6	-0.1	0	0	-1	-0.7	0	1	0	-0.15	0	0	-1	0	0	0	13662.5
0	S3	0	-0.5	0	1	0	0	-1	0	0	0	1	-0.5	0	0	-2	0	0	0	10575
1000	X5	0	0.125	-0.25	0	1	1	-0.5	0.5	0	0	0	0.375	0	0	-0.5	0	0	0	143.75
0	S5	0	-0.1875	-0.625	0.5	0	0	-1.75	-0.75	0	0	0	-0.5625	1	0	-2.25	0	0	0	2834.375
0	S6	0	-0.2125	-0.325	0	0	0	-0.4	-0.6	0	0	0	-0.1375	0	1	-0.15	0	0	0	255.625
1225	X1	1	1.25	1.5	1	0	0	2	1	0	0	0	-0.25	0	0	1	0	0	0	337.5
0	S8	0	-0.375	-2.25	1	0	0	-2.5	-3.5	0	0	0	-0.125	0	0	-2.5	1	0	0	1918.75
0	S9	0	-0.44375	-0.2825	0.09	0	0	-0.485	-0.625	0	0	0	-0.16125	0	0	-0.605	0	1	0	80.1875
0	Sg1	0	-0.25	0.5	0.5	0	0	0.5	0.75	0	0	0	0	0	0	0	0	0.5	1	-0.75
	ZJ	1225	1656.25	1587.5	1225	1000	1000	1950	1725	0	0	0	68.75	0	0	725	0	0		557187.5
	CJ-ZJ	0	-556.25	-587.5	-75	0	0	-800	-525	0	0	0	-68.75	0	0	-725	0	0		

The last equation in table 5 is the required Gomory constraint equation and represents the necessary conditions for 5 to be an integer. Each additional equation or Gomory constraint equation, the value of the right hand side is negative, it can be concluded that this cut is not feasible. So the dual simplex method is used for this inadequacy.

c) **Solving using the dual simplex method**

In table 6, the optimal solution is obtained in the second iteration using the dual simplex method where the coefficients in row z are positive or zero and none of the values on the right hand side are negative. Then the decision variable has an integer value.

Table 6. Optimal Simplex Table

CJ	CJ	1225	1100	1000	1150	1000	1000	1150	1200	0	0	0	0	0	0	0	0	0		
	VB	X1	X2	X3	X4	X5	X6	X7	X8	S1	S2	S3	S4	S5	S6	S7	S8	S9	Sg1	NK
0	S1	0	-6.5	4	4	0	-1	0	9.5	1	0	0	0	0	0	-4	0	7	14	15397.55
0	S2	0	-1.25	0.4	0.9	0	0	0	0.8	0	1	0	-0.15	0	0	-1	0	1	2	13662.15
0	S3	0	-1	1	2	0	0	0	1.5	0	0	1	-0.5	0	0	-2	0	1	2	10574.65
1000	X5	0	-0.125	0.25	0.5	1	1	0	1.25	0	0	0	0.375	0	0	-0.5	0	0.5	1	144
0	S5	0	-1.0625	1.125	2.25	0	0	0	1.875	0	0	0	-0.5625	1	0	-2.25	0	1.75	3.5	2833.763
0	S6	0	-0.4125	0.075	0.4	0	0	0	0	0	0	0	-0.1375	0	1	-0.15	0	0.4	0.8	255.485
1225	X1	1	2.25	-0.5	-1	0	0	0	-2	0	0	0	-0.25	0	0	1	0	-2	-4	338
0	S8	0	-1.625	0.25	3.5	0	0	0	0.25	0	0	0	-0.125	0	0	-2.5	1	2.5	5	1917.875
0	S9	0	-0.68625	0.2025	0.575	0	0	0	0.1025	0	0	0	-0.16125	0	0	-0.605	0	1.485	0.97	80.01775
0	Sg1	0	-0.5	1	1	0	0	1	1.5	0	0	0	0	0	0	0	0	1	2	0.35
	ZJ	1225	2631.25	362.5	725	1000	1000	0	1200	0	0	0	68.75	0	0	725	0	1950	3900	557870

The optimum solution using the cutting plane method in table 6 has been obtained with values x_5=144 and x_1=338 with = 557870.

IV. CONCLUSION

Based on the results of the study, it can be concluded. The optimum solution obtained from optimizing the profit of bread production at Home Industry Potatora Bakery using the linear programming method obtained a profit of . 557,188,5 by producing Bread boi chocolate (X1) = 337 packs and Bread streussel strawberry(X5) = 143.75 packs. While the completion of optimization of bread production profit at Home Industry Potatora Bakery using the cutting plane method, the profit is . 557,870 by producing Bread boi chocolate (X1) = 338 packs and Bread streussel strawberry(X5) = 144.

The results of the comparison of the optimization of bread production profits using the linear programming and cutting plane methods are obtained that the benefits obtained by using the cutting plane method are more leverage than the linear programming method.

Based on the research that has been done, it is expected that Potatora Bakery can implement a raw material inventory control system so that all resources can be used as optimally as possible to get a more optimal amount of production. In addition, it can also be done by expanding product marketing targets, so that the amount of production and the amount of raw material inventory can increase and increase profits will be obtained. and for further development, researchers also suggest using other, simpler methods in solving optimization problems with a large number of decision variables and constraint functions.

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