Optimization of Material Requirement Planning Using A Linear Program

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A B S T R A C T

This study discusses the optimization of the production cost of dodol using Material Requirement Planning (MRP) with a linear programming to solve the problem of optimizing production costs in the dodol pulut sari business. This study identifies the MRP model, determines the objective and constraint functions of the MRP model, then optimizes the MRP model into a linear programming using the simplex method. There are various constraint function encountered in the company by modeling them into MRP, namely the main raw materials such as pulut, sugar, coconut milk, vanilla, management time, and waiting time for orders. While the objective function is to minimize production costs. The results of the MRP optimization study with a linear programming obtained Rp. 10.368.000 and has a difference with the costs incurred by the company of Rp. 80.000. therefore, the production cost of the MRP model by optimizing the linear programming using the simplex method is more efficient and can be used to solve problems in minimizing production costs.

Keywords:

Production of Dodol, Material Requirement Planning (MRP), Optimization, Linear Programming, Simplex Method

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1. INTRODUCTION

Material Requirement Planning (MRP) is a bound demand model that uses the material requirement list, inventory status, estimated receipts, and master production schedule to determine the material requirement to be used. MRP can be used in forecasting future material requirement before production begins. This can be useful for overcoming the excess stock of materials to be produced by controlling the purchase of materials from suppliers. The results of the MRP calculation are in the form of the amount and when to purchase materials ordered from suppliers. For things that are more widespread, the use of MRP can also be used to calculate the cost of storing materials in a warehouse[1].

MRP is used in its optimal form to determine the lowest cost and highest quality. The main focus of MRP research is to minimize the total cost. Significant benefits of MRP are improved customer service, better production scheduling, and reduced production costs. In order for MRP to be made properly, MRP requires several main inputs that must be met. The main input is the basic component of MRP which consists of Master Production Schedule (MPS), Bill of Materials (BOM), Product Structure, Inventory Records, and Lead Time. In MRP there are also several techniques used in MRP calculations, including Lot for lot (LFL), Economic Order Quantity (EOQ), and Fixed Order Quantity (FOQ)[2].

In the world of manufacturing, there are important problems faced, including uncertainty about the final amount of products, such as demand levels, production costs, and many other factors that ultimately affect production levels. In production planning, there are usually several constraints and limitations that affect the output level of a production plant, such as available manufacturing resources and human resource aspects. Without a good production plan, the company's goals will not be achieved effectively and efficiently, so that existing production factors will be used wastefully[3].

Optimization is the process of minimizing costs to a minimum to get the maximum possible profit from a problem. Production optimization is needed by the company in order to optimize the resources used so that a production can produce products in the expected quantity and quality, so that the company can achieve its goals. With this optimization, it is hoped that it can help companies maximize sales to get better profits. Optimization can be achieved in two ways, namely maximization and minimization. Maximization is product optimization by using or allocating certain inputs to get maximum profit. Meanwhile, minimization is the optimization of production to produce a certain level of output using the minimum input or cost[4].

One of the optimization approaches that can be used in the process of obtaining a solution and solving an optimization problem is the Linear Program. Linear programming is a way to solve the problem of allocating limited resources among several competing activities in the best way. Linear programming is as a mathematical model associated with standard form optimization problems, either to maximize or minimize the objective function with respect to specific constraints.

Linear programming is a way of solving optimization problems by modeling it in the form of objective functions and constraints, both of which are linear in form. Furthermore, specifically linear programming is a process of determining variable values on constraints that are formed by taking into account existing constraints which are usually expressed in the form of linear equations and inequalities (linear inequalities). In the linear programming model, there are two kinds of functions, namely objective functions and constraint functions. The objective function is a function that describes the goals/objectives in linear programming problems related to optimal management of resources, to obtain maximum profit or minimum cost. In general, the value to be optimized is expressed as Z. Meanwhile, the constraint function is a form of mathematical representation of the available capacity constraints that will be optimally allocated to various activities[5].

In solving linear programming problems, you must first translate the constraints contained in the linear programming problem into a mathematical formulation. This process is called a mathematical model. A mathematical model is said to be good if the model contains only the parts that are needed. as is the case in the production process of pulut sari dodol which has several obstacles in producing 3 types of dodol namely Original Dodol, Durian Dodol, and Cane Sugar Dodol. In producing dodol many types of materials are used and on a large scale, but in each production within a period of one month, these materials have not been utilized optimally. When the supply of materials has not been utilized optimally, the benefits obtained have not been maximized. The Pulut Sari dodol business has also not implemented a linear program in its production. This is one of the causes of factors that have not achieved optimum profit.

There are several methods to solve linear programming problems including the graphical method and the simplex method. The graphical method is a method that can only be used to solve problems where the decision variable is equal to two. Linear problems are not always simple because they involve many constraints and many variables, so it is impossible to solve them using graphical methods. While the simplex method can be used to solve problems where there are two or more decision variables.

The simplex method is a technique for solving iterative linear programs. The simplex method uses iteration where the same calculation steps are repeated until the optimal solution is obtained. Each stage of completion produces an objective function value which is always more optimum or the same as the previous stages of completion. The simplex method is very efficient and systematic, equipped with test criteria that can tell when calculations should be continued or stopped until the optimum solution is obtained. In the simplex method, the linear programming problem is always changed to a standard linear programming problem, where each limiting inequality is expressed in the form of a limiting equation by adding slack or surplus variables.

2. LITERATURE REVIEW

2.1 Optimization

In general, optimization means finding the best value (minimum or maximum) of several functions given in a context. Optimization can also improve performance so that it has good quality and high work results. Mathematically, optimization is a way to get extreme values, either maximum or minimum, of a certain function with its limiting factors[6].

2.2 Material Requirement Planning (MRP)

MRP is a useful system for calculating the amount of raw materials or components a company needs to produce an item. Mrp is used in its optimal form to determine the lowest cost and highest quality. The main focus of MRP is to minimize the total cost. The benefits of MRP are improved customer service, better production scheduling, and reduced production costs.

2.3 Main Input Material Requirement Planning (MRP)

For MRP to function and be operationalized effectively there are several requirements and assumptions that must be met. According to Diana (2013: 98) there are four inputs needed in the MRP concept, namely:

1. *Master Production Schedule* (MPS)
   MPS is a definitive statement about what end item the company plans to produce, what quantity is needed, when it is needed, and when the product will be produced. MPS is prepared in relation to marketing, distribution planning, production planning, and capacity planning.

2. *Bill Of Material* (BOM)
   Includes a list of items or materials needed for assembling, blending, and making the final product. The BOM is created to determine which items to purchase and which items to manufacture.
3. Product Structure
   Is an overview of the steps or process of making a product, starting from raw materials to the final product.
4. Lead Time
   This lead time is necessary considering that MRP has a time phase dimension which will greatly affect the pattern of component inventory. Lead time is the time required from when an item order is placed until the item is received and ready to be used, both self-made product items and product items ordered from outside the company.

2.4 Linear Programming

Linear programming is the most powerful operational research method and is widely used in decision making in the business sector. In general, linear programming is a way of solving optimization problems by modeling it in the form of objective functions and constraints, both of which are linear in form. Specifically, linear programming is a process of determining variable values on constraints that are formed by taking into account the availability limits which are usually expressed in the form of linear similarities and inequalities (linear inequalities). Based on the variable values obtained will be able to optimize the objective function. Linear programming is closely related to problems in the real world. This real problem is translated as a mathematical model consisting of a linear objective function and several linear constraints. The objective function is to maximize profits or minimize costs from limited resources.

The linear programming model is the form and arrangement of presenting the problems to be solved by linear programming techniques. In the linear programming model, there are two kinds of functions, namely objective functions and constraint functions. The objective function is the function whose value is to be optimized. The objective function can be a maximum or a minimum. This depends on the case. If the objective function is production costs, the minimum value is sought. However, if the objective function is profit, the maximum value is sought. While the limit function is the constraints that must be met by the variables contained in the objective function.

Table 1. Data for Linear Programming Models

Source Activities	Use of Resources Per Unit Activities					Source Capacity
	1	2	3	. . .	N	
1	$a11$	$a12$	$a13$	. . .	$a1n$	$b1$
2	$a21$	$a22$	$a23$	. . .	$a2n$	$b2$
3	$a31$	$a32$	$a33$	. . .	$a3N$	$b3$
.	.	.	.	. . .	.	.
.	.	.	.	. . .	.	.
.	.	.	.	. . .	.	.
M	$am1$	$am2$	$am3$	. . .	amn	bm
Z increase per unit level of activity	$C1$ $X1$	$C2$ $X2$	$C3$ $X3$	. . . . . .	Cn Xn	

The linear program model uses the following symbols :

m = Kinds of resource limitations or available facilities.

n = Types of activities that use these resources or facilities.

i = The number of each type of resource or facility available $[i = 1,2,3, \dots , m]$

j = The number of each type of activity that uses available resources or facilities $[j = 1,2, \dots , n]$

Xj = Activity level to j $[j = 1,2, \dots , n]$

a_{ij} = The number of sources i required to produce each unit of output or activity output [i = 1,2, … , m dan j = 1,2, … , n]

b_i = Many resources I are available to be allocated to each activity unit [i = 1,2, … , m]

Z = Optimized value (maximum or minimum)

C_j = An increase in the value of Z if there is an increase in the level of activity [X_j] by one unit or is a contribution for each unit of activity output to the Z value.

On the basis of the table above, a mathematical model can be eveloped to present a linear programming problem as follows :

1. The objective function is maximizing

$$Z = C_1X_1 + C_2X_2 + C_3X_3 \ldots + C_nX_n$$

Where :

$Z =$ Objective Function

$C_n =$ The coefficient of the objective function

$X_n =$ Decision variable

2. Fulfills the constraints

$$a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + \cdots + a_{1n}X_n \leq b_1$$
$$a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + \cdots + a_{2n}X_n \leq b_2$$
.
.
.
$$a_{m1}X_1 + a_{m2}X_2 + a_{m3}X_3 + \cdots + a_{mn}X_n \leq b_m$$

and

$$X_1 \geq 0, X_2 \geq 0, \ldots, X_n \geq$$

Constraints for linear programming problems generally include :

a. The relationship between the decision variables it self.
b. The relationship between decision variables and each limited and available source.The relationship between the decision variables with each performance or target goals.

2.5. Simplex Method

The simplex method is one of the solutions for linear programming where the process of finding a solution is by using the iteration path, namely determining the feasible point of the goal to be achieved with the help of a table to obtain an optimal solution. The simplex method starts with one by one feasible point test to determine whether the objective function to be achieved has achieved optimal results or has not achieved optimal results. When the results obtained from one feasible point have not reached optimal results, then proceed with the next feasible point, and so on until the objective function to be achieved obtains optimal results if it exists[7].

It should be noted the steps in completing the simplex method, these steps are [8]:

1. Changing the objective function with constraints, after all the objective function are changed, the objective function is changed to an implicit function, its C_n is shifted to the left.

2. Arrange equations into simplex table from.
3. Selecting the key column, the key column to be selected is seen from the row of the objective function which has the smallest negative value.
4. Selecting the ey row, the key row is selected by looking at the smallest ratio value. The ratio value is obtained from the division between the right value and the key column value.
5. Changing the value of the key row, the value of the key row is changed by dividing all values in the key row by the key number. Then there will be exit variables and incoming variables.
6. Change the values in the key row with the formula.
   New Row = Old Row – (Coefficient per Key Column × Key Row Value)

Continuing repairs or changes. Repeat steps 3-6, until optimal results are found. Optimal results will be obtained when the value of the objective function becomes all positive.

2.6. Dodol

Dodol is a traditional sweet snack made from glutinous rice flour, coconut milk, granulated sugar, palm sugar, and other ingredients. The ingredients for making dodol are not difficult to find, it's just that it takes time and special skills to process them so that they become good quality dodol. This dodol business in its production process still uses relatively simple equipment.

3. RESEARCH METHODOLOGY

3.1. Research Stages

The stages carried out in this study are shown in Figure 1

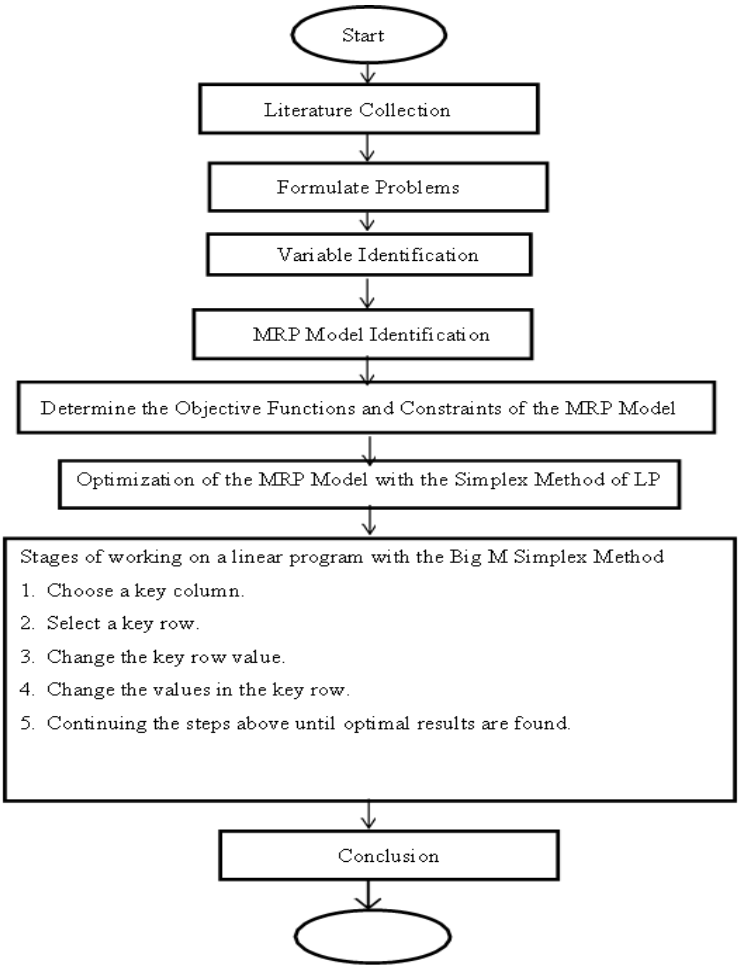

Figure 1. Flowchart

3.2. Research Procedure

The procedures or stages that will be carried out in analyzing this research to get the best model are as follows:

1. Collection of literature as a source of scientific research.
2. Formulate the problem
3. Identify Variables
4. Identify the MRP Model
5. Determine the objective function and constraint function of the MRP Model
6. Optimization of the MRP model with the simplex method of linear programmin
7. The steps for working on the simplex method are as follows :
   a. Changing the objective function with constraints, after all the objective function are changed, the objective function is changed to an implicit function, its C_n is shifted to the left.
   b. Arrange equations into simplex table from.
   c. Selecting the key column, the key column to be selected is seen from the row of the objective function which has the smallest negative value.
   d. Selecting the ey row, the key row is selected by looking at the smallest ratio value. The ratio value is obtained from the division between the right value and the key column value.
   e. Changing the value of the key row, the value of the key row is changed by dividing all values in the key row by the key number. Then there will be exit variables and incoming variables.
   f. Change the values in the key row with the formula.
   New Row = Old Row – (Coefficient per Key Column × Key Row Value)
   g. Continuing repairs or changes. Repeat steps 3-6, until optimal results are found. Optimal results will be obtained when the value of the objective function becomes all positive.
8. The calculation of the simplex method requires the addition of slack/surplus variables and requires several iterations to reach the optimum solution.
9. Draw a conclusion.

4. RESULT AND DISCUSSION

4.1. Research Data on Production Results

Producing dodol requires several factors of production such as raw materials, amount and production time, and operational costs.

a. Raw Material
Raw materials are the most important factor in the production process, without raw materials the production process will not run. The supply of these raw materials is not arbitrary but requires proper planning of raw materials. The main raw materials for producing dodol are pulut, sugar, coconut milk, vanilla. The availability of raw materials for producing dodol can be seen in the following table:

Table 2. Availability of Raw Materials Per Month

No	Raw Materials	Availability	Unit	Price (Rp)
1	Pulut	96	Kg	25.000/Kg
2	Sugar	128	Kg	18.000/Kg
3	Coconut Cream	84	Kg	30.000/Kg
4	Vanilla	48	Sachet	500/Sachet
5	Palm Sugar	96	Kg	15.000/Kg
6	Durian	8	Kg	50.000/Kg

Table 3. Data on the Need for Original Dodol Raw Materials for Once Production

No	Raw Materials	Unit	Original Dodol	Cost (Rp)
1	Pulut	Kg	4	100.000
2	Palm Sugar	Kg	6	90.000
3	Sugar	Kg	3	54.000
4	Coconut Cream	Kg	3.5	105.000
5	Vanilla	Sachet	2	1.000
Total				350.000

Table 4. Data on the Need for Raw Materials for Durian Dodol in One Production

No	Raw Materials	Unit	Durian Dodol	Cost (Rp)
1	Pulut	Kg	4	100.000
2	Palm Sugar	Kg	6	90.000
3	Sugar	Kg	3	54.000
4	Coconut Cream	Kg	3.5	105.000
5	Vanilla	Sachet	2	1.000
6	Durian	Kg	1	50.000
Total				400.000

Table 5. Data on the Need for Raw Materials for Cane Sugar Dodol in One Production

No	Raw Materials	Unit	Cane Sugar Dodol	Cost (Rp)
1	Pulut	Kg	4	100.000
2	Coconut Cream	Kg	3.5	105.000
3	Vanilla	Sachet	2	1.000
4	Cane Sugar	Kg	10	180.000
Total				386.000

b. Quantity and Production time

The amount to produce dodol is influenced by the length of time it takes to produce good dodol. The maximum production amount for each product and the length of time for dodol production can be seen in the following table :

Table 6. Maximum Production Amount of Each Product

Types of Products	Number of Product
Duria Dodol	16 Kg
Original Dodol	16 Kg
Cane Sugar Dodol	16 Kg
Total	48 Kg

Table 7. Length of Production

Jenis Produk	Production time (Hours)
Durian Dodol	4
Original Dodol	4
Cane Sugar Dodol	4
Minimum	96

c. Operating Cost
Production costs for producing three types of dodol products in the form of raw material costs, and other additional costs are referred to as operational costs. The costs used in producing the three types of dodol pe Kg can be seen in the following table.

Table 8. Operational Costs for One Production

Types of Products	Price (Rp)	Raw Material Costs	Wages	Message Fee (Rp)
Duria Dodol	50.000/Kg	350.000	50.000/Cauldron	20.000
Original Dodol	60.000/Kg	400.000	50.000/Cauldron	20.000
Cane Sugar Dodol	30.000/Kg	386.000	50.000/Cauldron	20.000

4.2. Research Data on Production Results

4.2.1. Material Requirement Planning (MRP)

MRP is a useful system for calculating the amount of raw materials or components a company needs to produce an item. Mrp is used in its optimal form to determine the lowest cost and highest quality. The main focus of MRP is to minimize the total cost. The benefits of MRP are improved customer service, better production scheduling, and reduced production costs.

4.2.2. Material Requirement Planning (MRP)

The steps in the MRP system input are :

1. Master Production Schedule (MPS)
   In this study MPS is production planning and capacity planning, such as checking the availability of the main raw materials to be produced. In dodol the main ingredients are pulut, coconut milk, sugar and vanilla.
2. Bill Of Material (BOM)
   BOM includes goods or materials needed. In some types of dodol, such as durian dodol requires the addition of durian, and cane sugar dodol uses cane sugar.
3. Product Structure
   The product structure is the process of processing dodol in the dodol pulut sari business
4. Lead Time
   The lead time required for dodol pulut sari to wait for the raw materials to arrive after being order is 2 days with 8-9 working days a month.

MRP is used in its optimal form to determine the lowest cost and highest quality. The main focus of MRP research is to minimize the total cost. Significant benefits of MRP are improved customer service, better production scheduling, and reduced production costs.

1. Decision Variable

   $X_1 =$ Original Dodol

   $X_2 =$ Durian Dodol

   $X_3 =$ Cane Sugar Dodol

2. Objective Function

The objective function of MRP is to minimize production costs. The costs incurred in producing Original Dodol ($X1$) including raw material costs, wages, and ordering costs are IDR 420,000 per production, Durian Dodol ($X2$) is IDR 470,000 per production, and Cane Sugar Dodol ($X3$) is Rp. 456.00 per production. Therefore, the objective function can be formulated as follows:

$$Minimumkan : Z = 420.000\ X_1 + 470.000\ X_2 + 456.000\ X_3$$

3. Constraint Function

The data in the constraint function are assumed to be from the main inputs of MRP, namely MPS, BOM, Product Structure, and Lead Time. MPS and BOM can be assumed as a function of MRP raw material constraints, product structure is assumed as a function of MRP management time constraints, and Lead Time is assumed to be a function of MRP constraints waiting time for the next order.

The constraints on dodol raw materials can be seen from the data on the main raw materials for the production of the three dodols, namely Pulut, Palm Sugar, Granulated Sugar, Coconut Milk and Vanilla. For the original dodol production, 4 kg of pulut is the main raw material, 3 kg of granulated sugar, 3.5 kg of coconut milk, and 2 sachets of vanilla. Durian dodol uses the main raw materials such as raw materials for making original dodol, namely 4 kg of pulut, 3 kg of granulated sugar, 3.5 kg of coconut milk, and 2 sachets of vanilla. Whereas in cane sugar dodol the main raw material for pulut is 4 kg, coconut milk is 6 kg, vanilla is 3.5 sachets and cane sugar is 10 kg. With a minimum that must be provided for pulut 96, sugar 128, coconut milk 84, and vanilla 48.

Management time constraints can be seen in the data on the length of production time for the three dodols. For original dodol, durian dodol and cane sugar dodol the processing time is 4 hours for one production with a minimum processing time of 96 hours.

The constraints on the waiting time for orders are from the assumption of lead time where in the third production of dodol pulut sari to wait for the arrival of raw materials after being ordered is 2 days with a total of 8 working days a month.

Table 9. Function of Production Constraints in the MRP Model

No	Product	Pulut	Sugar	Coconut Cream	Vanilla	Management Time	Lead Time
1	Original Dodol	4	3	3,5	2	4	2
2	Durian Dodol	4	3	3,5	2	4	2
3	Cane Sugar Dodol	4	10	3,5	2	4	2
	Minimum	96	128	84	48	96	8

With Constraints :

Pulut	: $4\ X_1 + 4\ X_2 + 4\ X_3 \geq 96$
Sugar	: $3\ X_1 + 3\ X_2 + 10\ X_3 \geq 128$
Coconut Cream	: $3{,}5\ X_1 + 3{,}5\ X_2 + 3{,}5\ X_3 \geq 84$
Vanilla	: $2\ X_1 + 2\ X_2 + 2\ X_3 \geq 48$
Management Time	: $4\ X_1 + 4\ X_2 + 4\ X_3 \geq 96$
Lead Time	: $2\ X_1 + 2\ X_2 + 2\ X_3 \geq 8$

$X_1, X_2, X_3 \geq 0$

4.2.3. Application of the Big M Simplex Method Linear Program with the MRP Model

Judging from the function, the objective of MRP is to minimize production costs and the constraints are the main raw materials, processing time, and waiting time for orders.

$$\text{Min } Z = 420.000\, X_1 + 470.000\, X_2 + 456.000\, X_3$$

$$4\, X_1 + 4\, X_2 + 4\, X_3 \geq 96$$

$$3\, X_1 + 3\, X_2 + 10\, X_3 \geq 128$$

$$3{,}5\, X_1 + 3{,}5\, X_2 + 3{,}5\, X_3 \geq 84$$

$$2\, X_1 + 2\, X_2 + 2\, X_3 \geq 48$$

$$4\, X_1 + 4\, X_2 + 4\, X_3 \geq 96$$

$$2\, X_1 + 2\, X_2 + 2\, X_3 \geq 8$$

$$X_1, X_2, X_3 \geq 0$$

Changed into canonical form by adding slack, surplus and artificial variables

$$\text{Min} \quad Z \quad = 420.000\, X_1 + 470.000\, X_2 + 456.000\, X_3 + 0S_1 + 0S_2 + 0S_3 + 0S_4 + 0S_5 + 0S_6 + MA_1 + MA_2 +$$
$$MA_3 + MA_4 + MA_5 + MA_6$$

$$4\, X_1 + 4\, X_2 + 4\, X_3 - S_1 + A_1 = 96$$

$$3\, X_1 + 3\, X_2 + 10\, X_3 - S_2 + A_2 = 128$$

$$3{,}5\, X_1 + 3{,}5\, X_2 + 3{,}5\, X_3 - S_3 + A_3 = 84$$

$$2\, X_1 + 2\, X_2 + 2\, X_3 - S_4 + A_4 = 48$$

$$4\, X_1 + 4\, X_2 + 4\, X_3 - S_5 + A_5 = 96$$

$$2\, X_1 + 2\, X_2 + 2\, X_3 - S_6 + A_6 = 8$$

$$(X_1, X_2, X_3, S_1, S_2, S_3, S_4, S_5, S_6, A_1, A_2, A_3, A_4, A_5, A_6 \geq 0)$$

Iteration I

CB_j	C_j	420	470	456	0	0	0	0	0	0	M	M	M	M	M	NK
	BV	X_1	X_2	X_3	S_1	S_2	S_3	S_4	S_5	S_6	A_1	A_2	A_3	A_4	A_5	
M	A_1	0	0	0	-1	0	0	0	0	2	1	0	0	0	0	80
M	A_2	-7	-7	0	0	-1	0	0	0	5	0	1	0	0	0	88
M	A_3	0	0	0	0	0	-1	0	0	1.75	0	0	1	0	0	70
M	A_4	0	0	0	0	0	0	-1	0	1	0	0	0	1	0	40
M	A_5	0	0	0	0	0	0	0	-1	2	0	0	0	0	1	80
456	X_3	1	1	1	0	0	0	0	0	-0.5	0	0	0	0	0	4
Z = 358M + 1824	Z_j	**-7M + 456**	**-7M + 456**	**456**	**-M**	**-M**	**-M**	**-M**	**-M**	**11.75M – 228**	**M**	**M**	**M**	**M**	**M**	
	$Z_j - C_j$	-7M + 36	-7M – 14	0	-M	-M	-M	-M	-M	11.75M - 228	0	0	0	0	0	

Iteration II

CB_j	C_j	420	470	456	0	0	0	0	0	0	M	M	M	M	NK
	BV	X_1	X_2	X_3	S_1	S_2	S_3	S_4	S_5	S_6	A_1	A_3	A_4	A_5	
M	A_1	2.8	2.8	0	-1	0.4	0	0	0	0	1	0	0	0	44.8
0	S_6	-1.4	-1.4	0	0	-0.2	0	0	0	1	0	0	0	0	17.6
M	A_3	2.45	2.45	0	0	0.35	-1	0	0	0	0	1	0	0	39.2
M	A_4	1.4	1.4	0	0	0.2	0	-1	0	0	0	0	1	0	22.4
M	A_5	2.8	2.8	0	0	0.4	0	0	-1	0	0	0	0	1	44.8
456	X_3	0.3	0.3	1	0	-0.1	0	0	0	0	0	0	0	0	12.8
Z = 151.2M + 5836.8	Z_j	**9.45M + 136.8**	**9.45M + 136.8**	**456**	**-M**	**1.35M – 45.6**	**-M**	**-M**	**-M**	**0**	**M**	**M**	**M**	**M**	
	$Z_j - C_j$	9.45M – 283.2	9.45M – 333.2	0	-M	1.35M – 45.6	-M	-M	-M	0	0	0	0	0	

Iteration III

CB_j	C_j	420	470	456	0	0	0	0	0	0	M	M	M	NK
	BV	X_1	X_2	X_3	S_1	S_2	S_3	S_4	S_5	S_6	A_1	A_3	A_5	
M	A_1	0	0	0	-1	0	0	2	0	0	1	0	0	0
0	S_6	0	0	0	0	0	0	-1	0	1	0	0	0	40
M	A_3	0	0	0	0	0	-1	1.75	0	0	0	1	0	0
420	X_1	1	1	0	0	0.1429	0	-0.7143	0	0	0	0	0	16
M	A_5	0	0	0	0	0	0	2	-1	0	0	0	1	0
456	X_3	0	0	1	0	-0.1429	0	0.2143	0	0	0	0	0	8
Z = 10368	Z_j	**420**	**420**	**456**	**-M**	**-5.1429**	**-M**	**5.75M – 202.2857**	**-M**	**0**	**M**	**M**	**M**	
	$Z_j - C_j$	0	-50	0	-M	-5.1429	-M	5.75M – 202.2857	-M	0	0	0	0	

Iteration IV

CB_j	C_j	420	470	456	0	0	0	0	0	0	M	M	NK
	BV	X_1	X_2	X_3	S_1	S_2	S_3	S_4	S_5	S_6	A_1	A_5	
M	A_1	0	0	0	-1	0	1.1429	0	0	0	1	0	0
0	S_6	0	0	0	0	0	-0.5714	0	0	1	0	0	40
0	S_4	0	0	0	0	0	-0.5714	1	0	0	0	0	0
420	X_1	1	1	0	0	0.1429	-0.4082	0	0	0	0	0	16
M	A_5	0	0	0	0	0	1.1429	0	-1	0	0	1	0
456	X_3	0	0	1	0	-0.1429	0.1224	0	0	0	0	0	8
Z = 10368	Z_j	**420**	**420**	**456**	**-M**	**-5.1429**	**2.2857M – 115.5918**	**0**	**-M**	**0**	**M**	**M**	
	$Z_j - C_j$	0	-50	0	-M	-5.1429	2.2857M – 115.5918	0	-M	0	0	0	

Iterationi V

CB_j	C_j	420	470	456	0	0	0	0	0	0	M	NK
	BV	X_1	X_2	X_3	S_1	S_2	S_3	S_4	S_5	S_6	A_5	
0	S_3	0	0	0	-0.875	0	1	0	0	0	0	0
0	S_6	0	0	0	-0.5	0	0	0	0	1	0	40
0	S_4	0	0	0	-0.5	0	0	1	0	0	0	0
420	X_1	1	1	0	-0.3571	0.1429	0	0	0	0	0	16
M	A_5	0	0	0	1	0	0	0	-1	0	1	0
456	X_3	0	0	1	0.1071	-0.1429	0	0	0	0	0	8
Z = 10368	Z_j	**420**	**420**	**456**	**M - 101.1429**	**-5.1429**	**0**	**0**	**-M**	**0**	M	
	$Z_j - C_j$	0	-50	0	M - 101.1429	-5.1429	0	0	-M	0	0	

Iteration VI

CB_j	C_j	420	470	456	0	0	0	0	0	0	NK
	BV	X_1	X_2	X_3	S_1	S_2	S_3	S_4	S_5	S_6	
0	S_3	0	0	0	0	0	1	0	-0.875	0	0
0	S_6	0	0	0	0	0	0	0	-0.5	1	40
0	S_4	0	0	0	0	0	0	1	-0.5	0	0
420	X_1	1	1	0	0	0.1429	0	0	-0.3571	0	16
0	S_1	0	0	0	1	0	0	0	-1	0	0
456	X_3	0	0	1	0	-0.1429	0	0	0.1071	0	8
Z = 10368	Z_j	**420**	**420**	**456**	**0**	**-5.1429**	**0**	**0**	**-101.1429**	**0**	
	$Z_j - C_j$	0	-50	0	0	-5.1429	0	0	-101.1429	0	

After $Z_j - C_j \leq 0$

Therefore, the optimal solution is obtained with the variable value as

$$X_1 = 16$$

$$X_2 = 0$$

$$X_3 = 8$$

So, Min Z = Rp. 10.368.000

5. CONCLUSION

The problem of dodol production costs in the Dodol Pulut Sari business can be solved by applying the MRP model and the Simplex Linear Programming Method to minimize dodol production costs. Based on the research that has been done and the researchers can draw conclusions, namely that overall MRP gives positive results and is very helpful in the ongoing production process at dodol pulut sari companies, with the help of dodol pulut sari MRP you can find out optimization which is a process to minimize costs to a minimum for get the maximum possible profit in the company dodol pulut sari. The results of optimizing MRP profits with the simplex method obtained optimal profits of Rp. 10,368,000/month. The total cost of dodol production incurred by the lunkhead dodol figure is Rp. 10,448,000/month. The difference in production costs incurred in the lunkhead lunkhead business with production costs using the MRP model with the Simplex Method of Linear Programming Optimization is Rp. 80,000.

The production cost of the lunkhead lunkhead business is more optimal by using the MRP model with the optimization of the simplex method linear programming when compared to the production costs incurred by the pulut sari dodol business. Therefore the MRP model for optimizing the Linear Simplex Program can solve the problem or can be used to minimize the production costs of original dodol, durian dodol, cane sugar dodol.

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