The Calculation of Product Combination by Using Linear Programing Simplex Method to Profit Maximize at Roti Sahabat Palembang City

Afrizawati Afrizawati[1,*] Elisa Elisa [1], M.Riska Maulana Effendi[1], Paisal Paisal[1,]

Nurya Mellinda[1]

[1] *State Polytechnic of Sriwijaya*
[*]*Corresponding author. Email: afrizawati@polsri.ac.*

ABSTRACT

This reseach discussed about the calculation of product combinatioans by using a linear program simplex method to calculated product combinations maximize profits at Roti Sahabat. The datas for the preparation of this reseach was obtained through interviews with business owners to obtain primary data. Product of Roti Sahabat was located in Palembang City such as Pia bread and sponge bread which price of them idr 900 per pack. Roti Sahabat produces 24.000 pia bread and 28.800 sponge bread in every month. The production volume is only calculted based on customer demand. To calculated product combination reseach used the maximum simplex method of linear programming and obtained 0 combinations of pia bread and 62.207 for sponge roti, with profit of 30.109.768.2 for a month. The income earned before and after by using the maximum method was very different. Therefore the reseach has suggestion that roti sahabat must used product combination first to calculated the profit.

Keywords : *Product Combination, Program Linear, Maximum Simplex Method*

1. INTRODUCTION

Development is growing and more people was decided to become entrepreneurs, either by buying a brand or creating as a personal business in form service or goods. In addition, the opportunity to market products through socual media is now wider, making it easier for public to present their business. Many of UMKM in the communities will make indonesian peoples futher advance rather than alwyas relying on work prepared by goverment. Job opportunities that goverment prepared was shrinking day by day. In this case the people can realize te revival of goverment that goal of indonesian national income is through from entrepreneur.

Currently, many of business was moving in their production basic needs. One of them is in field food or cooking production. Because of production is a small form of business so the risk will have small too and its often easy to expand quickly. Basicly food needs were basic needs for everyone. Production is all activities that created to increase in use of goods or services. In economics the elements of production activities are needed of land labor and skills. Production

of activities are the pioneers of the company, because the company can carry out all the activities within company trough production product such as promotional activities, distribution of goods or services and making processes[1]. Through these productive activities company which can make customer sastify needs and fulfill market needs.

Roti sahabat Palembang city is a bakery company that was founded in 2001 and located on jalan Tunas Harapan Lorong Mawar RT. 10 RW.06 Sako district Sukamaju Palembang. Based on the result interview with the owner Roti Sahabat, they didnot accounted how many production product by detail to achieve level of profit, nor they calculated productions cost in detail. Therefore the management of a company must be able to decide how to used resources to obtain the highest production volume, so if the product was sold, it will definetely get a lot of sale and get profit.

In the linear model program, there are has two fuctions, namely the objective fuction and the contsraint fuction. The objective fuction is a fuction that describes the goals or objective in linear problem programming which related to resources optimization management

[2]. The contsraint fuction is the resource with the higher benefit or lower cost. When modelling had a purposed to archieved in a linear mathematicaly fuction.

Based on the datas from this reseach was obtained in last two years such as the output (volume), product saleand price of Roti Sahabat palembang.

Table 1. Estimated Average Production Cost, Production Volume, Total Sale Revenue and Profit Pia Bread Each Years 2018 till 2020

Year	Production Cost	Production Volume	Sales Volume	Total Sales Revenue
2018	Rp 158.112.000	345.600	344.500	Rp 311.040.000.
2019	Rp 131.328.000	259.200	258.000	Rp 233.280.000.
2020	Rp 103.968.000	216.000	214.300	Rp 194.400.000.

Source: Roti Sahabat, 2021

Table 1. showed estimated cost for making pia bread at least 3 years anyway, and there is also a table estimated cost of sponge (bolu) cake for last 3 years also.

Table 2. Estimated Average Production Cost, Production Volume, Total Sale Revenue and Profit Sponge (Bolu) cake Each Years 2018 till 2020

Year	Production Cost	Production Volume	Sales Volume	Total Sales Revenue
2018	Rp 158.112.000	345.600	344.500	Rp 311.040.000.
2019	Rp 131.328.000	259.200	258.000	Rp 233.280.000.
2020	Rp 103.968.000	216.000	214.300	Rp 194.400.000.

Sources: Roti Sahabat, 2021

As can be seen from the table above, we known the production and sale of profit from Roti Sahabat must achieved, how to avoid losses and how to plan for the future profitability of the company, so it will prevent the company from experience a decline in profitability as it is today. According the combination of linear production program to increase the profit or to find out decrease in profits therefore doesnt make the store lossesso the tittle of this reseach is Calculation of Combination Product By Using Linear Programing Simplex Method to Profit Maximize At Roti Sahabat Palembang.

2. LITERATURE REVIEW

2.1. Producet Definition

Product is the result of productiion activities carried out by producers to satify needs and desires of consumers. Products sold by consumers must be good qualit, affordable, easy to obtain and involved in promotional activities, so that consumers can interest in buying the company's product. Products can be sold in large quantities will provide income and make profit for the company. [3] states that aproduct is anything that can be offered to a market for attention, acquisition, use and consumption that can satify a want or need. Products are more than just things that can be measured. Products include physical goods, services, people, organizations, ideas or combination of these.

2.2. Production Combination

Product can be produced in various ways and technologie, although there are many production processes, they can be broadly devided into two categories, namely: companies are organization whose activities are producing. Production activities are activities that change the form of raw materials into final product (good and services)[8]. Companies need raw materials, machine tools and labor. The company cannot be separated from its production and operation functions because one of the company cannot be separated from its production and operation fuctions. Because one ofthe company's tasks is to produce goods and services. The company by raw and auxiliary materials and processes them manually into final products.

According, [4] combination of product is a comparisson of the amount between one product and another that must be produced within a certain period in order to obtain optimal income. Product combination problems occur in companies that produce more than one product. The problem is how to determine the quantity of each product and what type of product will be produced so that the company can be take advantage of existing resources and get as much profit as possible. Therefore, it can be concluded that product mix is a way of determining amount of various products produced by using production factors such as machinery, labor and raw materials. The company must be able to determine

the number and type of product to be produced firmly in order to obtain the best results. The number of types of products to be produced must be determined by calculating the cost and value of the product itself based on the ability of business resources to determine the best product combination for the highest profit.

2.3. Linear Programming

According to sweeney and colleagues in his book "introducton and Management Science" linear programming is a mathematical technique develop to assist a manager for making secisions. As [5] linear programming (LP) is used tp solve problems that require solving in the proccess or maximally or minimally by using mathematic techniques in the form of linear inequalities. Based on the liniear programming theory above, it can be concluded that linear programming is a technology that solves problems in a maximum or minimum procces to help companies. Liniear programming the mathematical modality of product combination problems can be described in the form of a linear curve (straight line). The implication of the linear nature requires proposionality and additivity.

2.4. Simplex Method

The simplex method is the process of repeating system procedures (literacy) until desired results is achieved. Therefore, this method replaces difficukt questionwith a series of simple questions. According to [6] the simplex method is one of the solutions of linear programming which teh process of finding a solition is using the literacy path, namely determining feasible point of the goal to be achieved with the help of table untill the optimal solution is obtained.

Table 3. Initial Simplex Table

asis	X_1	X_2	S_1	S_2	S_n	olusi
Z	$-C_1$	$-C_2$	0_1	0_2	0_3	0
S_1	a_{11}	a_{12}	1	0	0	b_1
S_2	a_{21}	a_{22}	0	1	0	b_2
...	…	…	…	…	…	…
S_n	a_{m1}	a_{mn}	…	…	1	b_m

Source: Zuhria Nasution, 2016

Information: Z = the objective function to be searched for the maximum or minimum value

Cn = Coefficient value of the objective decision variable Xn

Xn = nth decition variable

Sn = nth slack variable

A (mn) = resource request for every Xn m

Bm = number of resource provide

n = number of decision variables starting from 1,2,3...n

m = number of types of resource used starting from 1,2,3, m

teh objectives of fuctions a follows:

maximize $Z = X_1 C_1 + X_2 C_2 + S_1 0 + S_2) + S_3 0$

with limited : $a_{11} C_1 + a_{12} C_2 + 1 0_1 + 0 0_2 + 0 0_3 = b_1$

$$a_{21} C_1 + a_{22} C_2 + 0 0_1 + 1 0_2 + 0 0_3 = b_2$$

3. ANALYSIS

3.1. Calculation of the Optimal Production Result Combination

Calculation of te optimal combination production results in Roti Sahabat using linear program analysis tool, with the maximum simplex methode. From calculation above, several functions are obtained to determine the optimal production area, including

1. Purpose Fuunction
   Based on the previous calculation of the contribution margin, the objecive function is
   Max $z = 321.03 x + 484.03 y$
2. Limit Function
   Raw Material $= 503 x + 340 y \leq 21.864.00$
   Machine Capacity $= 0,2 x + 0,15 y \leq 9.120$
   Labor $= 0,006 x + 0,0083 y \leq 52.800$
   Working capital $= 578,97 x + 415,97 y \leq 25.876.000$

To create a matrix table in calculating the combination of production results using the maximum simplex methode linear program. The following things need to be done before entering the value of the objective fuctions and limit function into the table as follows:

1. Changing the objective function, the variables that are to the rigt of the equation sign are moved to the left. So that, the form of the equation becomes:
   $Z = 321,03 x + 484,03 y$
   $Z - 321,03 x - 484,03 y = 0$
2. Change the shape of boundary function from the inequality ($\leq$) into equation (=) by ading slack elements of variables S1, S2, S3 and S4 so that the boundary function becomes
   $503 x + 340 y + 1 S1 + 0 S2 + 0 S3 + 0 S4 = 21.864.000$
   $0,22 x + 0,13 y + 0 S1 + 1 S2 + 0 S3 + 0 S4 = 9.120$
   $0,006 x + 0,0083 y + 0 S1 + 0 S2 + 1 S3 + 0 S4 = 52.800$
   $578,97 x + 415,97 y + 0 S1 + 0 S2 + 0 S3 + 1 S4 = 25.876.000$
   where $x \leq 0$ and $y \leq 0$

After making these two changes, the objective and contarint function variables can be entered into the first simplex table as follows:

Table 4. First table Simpleks

Basic	X	Y	S1	S2	S3	S4	RHS/Solution
Z	-321,03	-484,03	0	0	0	0	0
S1	503	340	1	0	0	0	21.864.000/340 = 64.305,8824
S2	0,22	0,13	0	1	0	0	9.120/0,13 = 70.153,85
S3	0,006	0,0083	0	0	1	0	52.800/0,0083 = 6.361.445,78
S4	578,97	415,97	0	0	0	1	25.876.000/415,97 = 62.206,4091 Pivot Row

Source : processed data, 2021

Account and fulfill the table of second simpleks with do two ways:

```
Old Z          (-321,03     -484,03    0    0    0            0|        0   )
(-484,03) x NPR (-673,6971   -484,03    0    0    0   -1,161672| -30.109.768,2) –
New Z (352,6671  0                      0    0    0    1.161672| 30.109.768,2

Old S1 (503     340          1          0    0    0| 21.864.000 )
(340) x NPR     (473,229     340        0    0    0         0,816| 21.150.179,1) –
New S1          (229,771     0          1    0    0        -0.816|      713.820,9)

Old S2 (0,22    0,13         0          1    0    0|              9.120        )
(0,13) x NPR    (0,1809      0,13       0    0    0    0,000312| 8.086,8331) –
New S2          (0,0391      0          0    1    0   -0,000312|  1.003,1669 )

Old S3 (0,006   0,0083       0          0    1    0| 52.800 )
(0,0083) x NPR  (0,01155     0.0083     0    0    0        1,992|     516,3131) –
New S3          (-0,00555    0          0    0    1   -1,992|52.283,6869)
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Pivot Row or S4 change by Y cause of pivot column, Y value have negative higher, so that NPR more value for Y

Table 5. Second table Simpleks

Basic	X	Y	S1	S2	S3	S4	RHS/Solution
Z	352,6671	0	0	0	0	1.161672	30.109.768,2
S1	229,771	0	1	0	0	-0,816	713.820,9
S2	0,0391	0	0	1	0	-0,000312	1.003,1669
S3	-0.00555	0	0	0	1	-1,992	52.283,6869
Y	1,39185	1	0	0	0	0,0024	62.206,4091

Source : processed data, 2021

From the results of the calculation of the linear anlysis of the maximum simplex method program in the second simplex table, it can be seen that all numbers on the Z line are positive [9]. This means that the second simplex table are optimal and showed the combination of production of x (Pia bread) an y (sponge bread). The RHS / solution table decribes the amount of production produced by Roti Sahabat with each amount as follow

X (Roti Pia)　　　　= 0 unit
Y (Roti Bolu)　　　= 62.206,4091 unit
Pia bread (x) has a value of 0,because in the second simplex table,row of Z there are no more negative number, so there is no need to calculated the third simplex table which to find the value of X. The positive X value is 0

The advantage obtained by Roti Sahabat use the optimal production combination above are:

$$Z = 321{,}03 \ x \ + 484{,}03 \ y$$
$$Z = 321{,}03 \ (0) + 484{,}03 \ (62.206{,}4091)$$
$$Z = 0 \quad + 30.109.768{,}2$$
$$Z = 30.109.768{,}2$$

3.2. Comparison of Product Combination and Production Profits Real with Product Combinations and production Advantages Simplex maximum Method

From the calculation results above, we can compare the number of combinationof real products with results of simplex calculation or compared real profits with the results of simplex calculation. For comparison the following table lists the real situation and simplex calculations.

Table 6. Comparison of real product and product combinationsion Simpleks Methode

Product Combination	Production cost		Production Volume		Profit
	Roti Pia	**Roti Bolu**	**Roti Pia**	**Roti Bolu**	
Real	Rp 12.072.000	Rp 9.792.000	24.000	28.800	Rp 21.644.784
Simplex Method	-	Rp 21.864.000	-	62.207	Rp 30.109.768,2

Source : processed data, 2021

From the data above, it can be explained that in real conditions the combination of Roti Pia and Sponge bread are 24.000 and 28.800 respectively and the monthly profit is idr.21.644.784. however the owner of Roti Sahabat used combination of product by calculated the maximum simplex method. The maximum profit obtained is idr. 30.109.768.2 in a month, where Roti Sahabat does not produce Pia bread and produces 62.206.4091 units or 62.207 units of sponge bread in a month. If used daily the maximum output of Sponge Bread after use the simplex method.

4. CONCLUSION

The results of this reseach and analysis based on the datas described in chapter III as follows
1. The combination of Roti Sahabat products calculated using the maximum simplex method. Linear program from Roti Sahabat only produces Sponge Bread and doesnot Pia Bread. The number of sponge bread must be produced at 62.207.4091 or 62.207 per month, or in a day Sponge bread should produce around 2.592 for maximum profit takes.
2. The maximum profit that can be achieved by Roti Sahabat (Calculated using the maximum simplex method linear program) was idr 30.109.768.2 in a month. This calculated is much higher than the monthly profit obtained by Roti Sahaba. Which was previously calculated based on manual calculations by deduction the entry of spending money. The current profit of Roti Sahabat is only idr. 21644.482 per month

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