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EFFORT TO MAXIMIZE PROFIT AND OPTIMIZE BOTH TIME AND BUSINESS CAPITAL RESOURCES THROUGH THE DETERMINATION OF MANY SMALL, MEDIUM AND LARGE PACKING UNITS IN THE "ENY" TEMPE CHIPS HOME INDUSTRY

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Abstract

Tempe chips are a superior product in Ngawi Regency. Some home-industries of tempe chips have also been negatively affected by the COVID-19 pandemic, including a decline in sales, difficulties in raw materials, capital problems and obstacles to the production process. Various efforts to increase sales have been carried out both through mentoring and research, among others by trying to do online marketing and designing better tempe chips packaging designs, but there has been no good planning on product composition.

From the interview, it is known that in determining the composition of the many packaging units of tempe chips and determining the selling price per unit, it is only based on experience while running a business and no optimization method has been used. Therefore, it is necessary to apply an optimization method to obtain maximum profit. In this research, we try to determine the number of production units for each type of tempe chips packaging that produces maximum profit and determine efficiency in the use of cost and time resources. Data collection techniques are carried out by observation and interviews. The simplex method was used to solve this research problem. We found that the home industry reached the maximum profit at 661 units of small packaging and 269 units of large packaging which gained IDR 23600 and time was reduced to 9.29 h.

Keywords: maximizing profits, number of production units, simplex method

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INTRODUCTION

As we know, the COVID-19 pandemic has had a negative impact on UMKM, especially in the East Java region, including a decline in sales, difficulties in raw materials, capital problems to production process barriers. Various efforts to increase sales have been carried out both through mentoring and research, among others by trying to do online marketing (Imron & Nurdian, 2021), and tempe chips packaging designs (Jessica, at al. 2015).

To maintain its existence, especially during the COVID-19 pandemic, companies are required to be more observant in dealing with all existing problems and other problems that may arise. Analysis related to the composition of the number of production units, the efficiency of the production capital used, determining the selling price and optimizing other resources owned by the company need to be carried out carefully and thoroughly. Determining the composition of the number of production units in a company is the main thing that needs attention for planning, because this has a direct effect on the company's profit.

Determining the composition of the number of production units to maximize company profits by looking at the company's limited resources can be solved using a linear programming model. There are several ways to solve problems with a linear programming model, including the simplex method. The Simplex method is the solution of a linear program model whose solution is presented in the form of a graph before which calculations were carried out to find common ground on each axis. The general procedure is to transform a descriptive situation into a linear programming problem by determining the variables, constants, objective functions, and constraints so that the problem can be presented in graphical form and the solution interpreted (Suwirmayanti, 2017).

A company and all its resources such as energy, time, money and others, in order to achieve real growth requires professional management, with the aim of obtaining maximum profit while using minimal resources (production capital). This is nothing but one of the optimization problems in operations research (Chandra, 2015).

This research was conducted in the home industry "ENY", in Ngawi Regency, East Java, which daily produces Tempe Chips, which are served in 3 packages, namely small packages, medium packages and large packages. During the COVID-19 pandemic, this company continued to carry out the production process every day, but by reducing the production volume, namely 600 small packaging units, 80 medium packaging units and 250 large packaging units. At the time of observation, information was obtained that the production volume was fixed every day, and production costs were also relatively fixed. The composition of the number of units for each type of packaging of tempe chips produced, and the selling price of the product per unit, are determined on the basis of experience while running the business, so there is no optimal planning or analysis method.

Based on this condition, the researcher wants to help the owner of the company to make a plan about determining the composition of the number of units for each type of packaging of tempe chips that must be produced so that the company obtains maximum profit, while taking into account the limited resources available.

The purpose of this study is to solve the problems faced by the company, by discussing the determination of the number of small packaging units, medium packaging and large packaging that must be produced so that the profit is maximum, calculating the maximum profit value in one day, calculating the efficiency (decrease) in resource use. limited, namely production capital and production time.

Some of the limitations and assumptions in this study are the total number of units of the three types of packaging tempe chips produced is the largest equal to the total number of units produced before the study, the total production time is the largest equal to the total production time before the study, the production capital is at most equal to the capital production before the study, the results of calculating the maximum profit value will be achieved with the assumption that all products are sold out.

The results of this study are expected to provide benefits, input and suggestions, especially for company owners in making decisions to change the composition of many production units for each type of tempe chip packaging, in order to obtain maximum profit.

The problem faced by this company is the Linear Programming Problem (LPP). Because the problem consists of 3 decision variables, the simplex method in a linear program is the right method to solve the problems experienced by the company, by decomposition of the many product units produced based on the limited resources available, with the aim of obtaining maximum profit (Christian, 2013).

Linear programming is a mathematical method with linear characteristics to find an optimal solution by maximizing or minimizing the objective function against the set of constraints (Budiasih, 2013).

The simplex method is a mathematical procedure to find the optimal solution of a linear programming problem based on an iterative process (Aulia et al., 2013).

Linear programming is an optimization technique used to obtain the most optimal solution for a real world problem. There are simplex method. The simplex method provides two methods to solve linear programming problems, namely the graphical method and the a systematic way of examining the vertices of the feasible region to determine the optimal value of the objective function. The "linprog" function in Mat Lab can be used to solve linear programming problems (Velinov & Gicev, 2018). One method that can be used to solve LPP is the Simplex Algorithm in Linear Programs (Sukanta, 2016).

The following are several studies related to the application of the simplex method for the purpose of optimizing the completion of LPP. (Rumetna et al., 2020) conducted a study entitled "Optimizing Revenue Making Banners and Billboards Using the Simplex Method (Case Study: Shiau Printing Printing Business)", from the analysis it is stated that Shiau Printing Printing can get a maximum profit of Rp. 15,000,000,- every month. (Fardiana, 2013) conducted a study entitled "Maximizing Profits at Martabak Doni Cake Shop with the Simplex Method", the results of data analysis are that the optimal combination of inputs obtained, will provide a maximum profit of Rp. 106,817,-. (Budiyanto, Mujiharjo, & Umroh, 2017) conducted a study with the title "Profit Maximization in the Roti Bunda Bakery Company Using the Simple Method" the results of the research were optimizing the use of resources, it would be able to increase profits from Rp. 1,663,914,- per week to Rp. 2,286,049,- per week. Akram, A. Sahari, and AI Jaya conducted a study entitled "Optimizing the Bread Production Method Using Branch And Bound" method Branch And Bound is solving technique that can be used not only on the LPP, but can be applied to a wide range of issues different. This method is used together with the simplex method (Akram, Sahari, & Jaya, 2016).

METHOD

Thinking Framework

Stages in the process of solving this research problem consist of:

1. Identification of research variables, profit functions, and limiting functions,
2. Compiling the problem into a mathematical model, in this case the form of linear program modeling,
3. Changing the mathematical model into a table simplex,
4. Perform an iterative process of solving with the algorithm in the simplex method, until the optimal table is obtained,
5. Presenting the optimal solution in mathematical language,
6. Interpreting the optimal solution of the research problem.

Data Collection Procedure

Collection was carried out by direct observation to the location and interviews, which were divided into two stages, as follows:

1. Preliminary observation, this stage was carried out to see firsthand the general condition of the company, and notify the research objectives to the company owner, so that the company understands the usefulness of the research results later, besides that at this preliminary stage the researcher can give a message to prepare data related to the data needed in research,
2. Data collection, at this stage interviews and clarification of the data that have

been collected prepared by the owner, with the hope that detailed and in-depth information can be obtained, related to the analysis plan to be carried out.

Data Analysis Techniques

1. Describing the Data.
   In this step, the transformation process is carried out from raw data from interviews, which are all materials and resources needed in the production process, into data that is ready for mathematical modeling.
2. The Identify Variables
   making:
   $X1$ = Many units small packaging should be produced
   $X2$ = Many units medium packaging should be produced
   $X3$ = Many units large packaging should be produced
3. Constraints
   total unit Production: $a11X1 + a12X2 + a13X3 \;\; b \leq 1$ (aij = 1, for every i and j)
   Total cost: $a21X1 + a22X2 + a23X3 \leq 2$
   Total time: $a31X1 + a32X2 + a33X3 \leq 3$
   Functions Advantages $Z = c1X1 + c2X2 + c3X3$
   mathematical models of research problems in general:
   Specifies $X1$, $X2$, and $X3$ with constraints:
   $a11X1 + a12X2 + a13X3 \leq 1$ (aij = 1, for every i and j)
   $a21X1 + a22X2 + a23X3 \leq 2$
   $a31X1 + a32X2 + a33X3 \leq 3$
   so that the values $X1$, $X2$, and $X3$ obtained will maximize the profit function $Z = c1X1 + c2X2 + c3X3$. Furthermore, this mathematical model will be solved by the simplex method.

   To complete the LPP the simplex method in the case of maximizing, mathematical models of LPP expressed as linear as follows:

Determine $X = [X_i, \mathrm{i} = 1,2,3, \dots, \mathrm{n}]$

Which satisfy the constraint: $A_{m\times n}X_{n\times 1}$ (≤, =)$_{\times 1}$

Optimizing $[Z1 \times 1 = C1 \times n \; nX \times 1]$.

Here are the steps to resolve the case of LPP to maximize the objective function in the simplex method:

1. Turn all obstacles to the canonical form by adding a variable (variable) Slack's. The existing slack variables are added to the target function and given a coefficient of 0, Step 1 causes the matrix A to be of size mx (n+m) and contains an identity matrix of order m. Continue by compiling the initial simplex table,
2. Determine the key column, which is to determine the incoming variable to be the new base variable.
   J column is the key column ↔(Zj - Cj)>0 smallest,
3. Determine the key lines that define variables which should be out long base being replaced by a new variable basis. I line is line ↔key index i> 0, the smallest,
4. ija called a key element, doing surgery rows: row i i new = old / ija
5. Perform row operations on the other lines so that the elements sekolom the key element to 0,
6. table ↔were optimal for all j values(Zj - Cj)>0,
7. If the table is not optimal return to step 2. (Sriwasito, Surarso, & Sarwoko, 2011).

To avoid data analysis with a lengthy iteration process, this study used POM QM for Windows software to help solve research problems.

RESULTS AND DISCUSSION

Data Description

Following is a description of the research data, which has been processed and reduced from the raw data obtained from interviews and observations.

Table 1

Observation Data

NO	NEED FOR	SMALL PACKAGING		MEDIUM PACKAGING		LARGE PACKAGING	
		MANY UNITS = 600		MANY UNITS = 80		MANY UNITS = 250	
		VOLUME	PRICE	VOLUME	PRICE	VOLUME	PRICE
1	Soybeans	36 kg	306.000	3 kg	25.500	45 kg	382.500
2	Ragi Tempe	4 ounces	20.000	2 ounces	4.000	5 ounces	25.000
3	Cooking Oil	36 L	396.000	3 L	33.000	45 L	495.000
4	Flour	36 kg	288.000	3 kg	24.000	45 kg	360.000
5	Garlic	8 ounces	20.000	2 ounces	4.000	1 kg	25.000
6	Pecan	4 ounces	12.000	2 ounces	6.000	5 ounces	15.000
7	Salt	4 ounces	4.000	2 ounces	2.000	4 ounces	4.000
8	Seasonings	5 gr	5.000	4 gr	4.000	5 gr	5.000
9	Eggseggs	12	12.000	0.5 kg	12.000	15 eggs	15.000
10	Coriander	3 ounces	6.000	2 ounces	4.000	3 ounces	6.000
10	WAGES		250.000		100.000		250.000
11	PACKAGING FEE		200.000		90.000		200.000
TOTAL		Rp 1.519.000		Rp 308.500		Rp 1.782.500	
CAPITAL/UNIT		Rp 2.550		Rp 3.900		Rp 7.150	
SELLING PRICE/UNIT		Rp 5.000		Rp 6.500		Rp 12.500	
TOTAL TIME		950 MINUTES		729 MINUTES		1.010 MINUTES	

Table 2
Description of Data Per Unit of Production

No	Type Packaging	Many Units	Total Cost	Total Time	Cost per Unit	Sellin g price per Unit	Time per Unit	Total Selling	Profit per unit
1	**Small**	600	1.519.000	950	2.550	5000	1,58	3.000.000	2.450
2	**Medium**	80	308.500	729	3.900	6.500	9,11	520.000	2.600
3	**Large**	250	1.782.500	1.010	7.150	12.50 0	4,04	3.125.000	5.350

TOTAL	930	3.610.000	2.689	-	-	-	6.645.000	-

From table 1, it can be calculated that the initial profit value = 6,645,000 – 3,610,000 = 3,035,000 rupiah.

Mathematical Modeling

X_1 = Many small packaging units produced
X_2 = Many medium packaging units produced
X_3 = Many large packaging units produced

The mathematical model of this research problem is :
Determining $X_1, X_2,$ dan X_3 with constraints :
Total Production Units :

$X_1 + X_2 + X_3 \leq 930$

Total cost : $2.550\ X_1 + 3.900\ X_2 + 7.150\ X_3 \leq 3.610.000$

Total time : $1{,}58\ X_1 + 9{,}11\ X_2 + 4{,}04\ X_3 \leq 2.689$

$X_1, X_2, X_3 \geq 0$

so that the values of $X_1, X_2,$ dan X_3 obtained will maximize, the profit function :

$Z = 2.450\ X_1 + 2.600\ X_2 + 5.350\ X_3$

The first simplex table, compiled by changing all the constraint functions in implicit form, by adding a slack variable S_1, S_2, dan S_3

$X_1 + X_2 + X_3 + S_1 = 930$

$2.550\ X_1 + 3.900\ X_2 + 7.150\ X_3 + S_2 = 3.610.000$

$1{,}58\ X_1 + 9{,}11\ X_2 + 4{,}04\ X_3 + S_3 = 2.689$

$X_1, X_2, X_3, S_1, S_2, S_3 \geq 0$

The implicit form of the profit function:

$Z - 2.450\ X_1 - 2.600\ X_2 - 5.350\ X_3 = 0$

The first simplex table is:

Table 3
Simplex First Table

Basis	X_1	X_2	X_3	S_1	S_2	S_3	H
S_1	1	1	1	1	0	0	930
S_2	2.550	3.900	7.150	0	1	0	3.610.000
S_3	1,58	9,11	4,04	0	0	1	2.689
Z	-2.450	-2.600	-5.350	0	0	0	0

Furthermore, to analyze the research data used software POM QM for Windows. The input of research problem data into POM QM is shown in the following table:

Table 4
Input Data

	X1	X2	X3		RHS	Equation form
Maximize	2450	2600	5350			Max 2450X1 + 2600X2 + 5350X3
Many units	1	1	1	<=	930	X1 + X2 + X3 <= 930
Production Cost/unit	2550	3900	7150	<=	3610000	2550X1 + 3900X2 + 7150X3 <= 3610000
Production Time/unit	1,58	9,11	4,04	<=	2689	1,58X1 + 9,11X2 + 4,04X3 <= 2689

Results of Data Analysis

The results of data processing using POM-QM are shown in the following tables:

Table 5

Linear Programming Result

	X1	X2	X3		RHS	Dual
Maximize	2450	2600	5350			
Constraint 1	1	2600	1	<=	930	842.39
Constraint 2	2550	3900	7150	<=	3610000	.63
Constraint 3	1.58	9.11	4.04	<=	2689	0
Solution	660.76	0	269.24		3059294.0	

Table 6
Solution List

Variable	Status	Value
X1	Basic	660.76
X2	NONBasic	0
X3	Basic	269.24
slack 1	NONBasic	0
slack 2	NONBasic	0
slack 3	Basic	557.27
Optimal Value (Z)		3059294.0

Table 7
Iteration

Cj	Basic Variables	Quantity	2450 X_1	2600 X_2	5350 X_3	0 slack 1	0 slack 2	0 slack 3
Iteration 1								
0	slack 1	930	1	1	1	1	0	0
0	slack 2	3,610,000	2,550	3,900	7,150	0	1	0
0	slack 3	2,689	1.58	9.11	4.04	0	0	1
	zj	0	0	0	0	0	0	0
	cj-zj		2,450	2,600	5,350	0	0	0
Iteration 2								
0	slack 1	425.1049	0.6434	0.4545	0	1	-0.0001	0
5350	X3	504.8951	0.3566	0.5455	1	0	0.0001	0
0	slack 3	649.2238	0.1392	6.9064	0	0	-0.0006	1
	zj	2,701,188.75	1908.04	2918.18	5350	0	.75	0
	cj-zj		541.958	-318.1818	0	0	-0.7483	0
Iteration 3								
2450	X1	660.7609	1	0.7065	0	1.5543	-0.0002	0
5350	X3	269.2391	0	0.2935	1	-0.5543	0.0002	0
0	slack 3	557.2717	0	6.808	0	-0.2163	-0.0005	1
	zj	3,059,293.5	2450	3301.09	5350	842.39	.63	0
	cj-zj		0	-701.087	0	-842.3913	-0.6304	0

Interpretation of Data Analysis Results

From the results of data analysis, several things can be explained as follows:

Table 7. It is an iterative process from the initial simplex table to obtain an optimal table that describes the optimal conditions with variable values that have been obtained.

Table 6. illustrates the solution to the linear programming problem, it can be seen that the maximum profit value per production period that can be achieved is 3059294.0 rupiah, achieved at conditions X1 = 660.76, X2 = 0 and X3 = 269.24. If Xrounded up1 = 661 is, X2 = 0 and X3 = 269, this means that to obtain maximum profit, the company must produce 661 units of small packaging and 269 units of large packaging, with a maximum profit of: Zmax = 2,450 (661)+2,600 (0)+5,350 (269) = 3,058,600, with production costs :

Optimal Production Cost = 2,550(661) + 3,900(0) + 7,150(269) = 3,608,900 rupiah (there was a decrease in costs production of 3,610,000-3,608,900 = 1,100 rupiah). From Table 6. The value of the slack 3 variable is 557.27, this shows that if the optimal conditions are implemented, the total time used is 557.27 minutes shorter than the previous total time. In real terms, it can be shown that: Total optimal time = 1.58(661) + 9,11(0) + 4.04(269) = 2.131.14 minutes. Time difference = 2.689 – 2.131.14=557.86 minutes (the difference is due to the above rounding).

In summary, the efficiency obtained by the company, after data analysis is presented in the following table:

Table 8
Efficiency of Research Results

	Initial Condition	**Final Condition**	**Efficiency**
Production	600 units small pack 80 medium pack 250 units big pack Number of units 930	661 units small pack 0 medium pack 269 units big pack Number of units 930	-
Prod. Cost (Rp.)	3.610.000	3.608.900	1.100
Time (Minutes)	2.689	2.131,14	557,86
Profit (Rp.)	3.035.000	3.058.600	23.600

CONCLUSION

To be able to achieve a maximum profit of 3,058,600 rupiah, the company must produce 661 units of small packaging and 269 large packaging and the company gets an additional profit of 23,600 rupiah per production period,

Under optimal conditions, the total production cost becomes 3,608,900 rupiah, there is an efficiency (decrease) of 1,100 rupiah.

If the company runs production according to optimal conditions, the time required is 557.86 minutes less than the production time before the study.

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