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Analysis of Maximum Profit From The Sale of Medan Floss Roll Using The Simplex Method And POM-QM Software

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ABSTRACT
Abstract Shredded bread rolls are examples of some original culinary products from Eastern Indonesia, especially in the region of West Papua. This product can also be made by tourists visiting West Papua and it is possible to buy it for daily consumption whether it's breakfast, lunch, dinner, or snack. The purpose of establishing the business is to preserve the cultural values in the region and improve the regional economy, so that it is therefore necessary to have a technique or method in determining the maximum profit. The simplex method is the method used in this study and utilizes information technologyuse of POM-QM tools to calculate the estimated cost of selling and shipping the product.

Keywords: *Maximization; Advantage; Simplex Method; POM-QM*

INTRODUCTION

Hawai Bakery's business of selling shredded bread rolls is one way to improve the welfare of the community and introduce examples of several culinary products typical of Eastern Indonesia, especially in the West Papua region, Indonesia. Shredded meat is a food processing in which the main ingredients such as meat or fish are chopped and dried by adding certain spices. Innovation from shredded products such as shredded bread rolls can be a promising business (Ismail and Putra, 2017). Then it was pressurized. In principle, shredded meat is a preservation product, which is a combination of boiling and frying by adding spices. The resulting products have a distinctive texture, aroma, and taste. In addition, the process of making shredded meat is a process of reducing the moisture content in food which aims to prolong the storage process (Jusniati, Patang and Kadirman, 2017). Shredded meat is one of the processed products that many people already know. According to SNI 01 3707-1995, shredded bread is a type of specialty-shaped dry food made from boiled and sliced, seasoned, fried, the purpose of this study is to calculate the maximum profit from the sale of Hawai Bakery rolled shredded bread. As well as to

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find out the use of the simplex method in the obstacles experienced by the Hawai Bakery rolled shredded bread business. In this study, one of the methods in Linear Programming is used, namely the simplex method. The simplex method was developed by George Dantzing in 1947. (Budiyanto, Mujiharjo and Umroh, 2017). The simplex method is the solution of a linear programming problem by looking for a feasible solution, and using an iterative procedure, developing the solution until an optimal solution is produced (Nasution et al., 2016). Linear programming (PL) is a form of mathematical model that uses programming language techniques to compile and solve optimization problems with objective functions and linear constraints (Chandra, 2015) (Firmansyah et al., 2018). Linear programming models are made up of specific components and characteristics. The components of the model include decision variables, objective functions and model constraints. The decision variable is a mathematical symbol that describes the level of the company's activities, for example, a bakery company wants to produce cheese bread (X1) and chocolate bread (X2), where X1 and X2 are symbols that indicate the number of variables of each unknown item (Budiasih, 2018). In addition to using PL, this study also uses POM-QM software for windows to make it easier to determine and calculate the maximum profit obtained from each sale made by the Hawaii Shredded Roll Shop within a period of one day precisely, so that it has accurate calculations and is expected to simplify and speed up the calculation process (Rumetna et al., 2019).

LITERATURE REVIEW

Linear Programming (Program Linier)

Linear Programming (LP) is a mathematical method used to determine the optimal solution to a problem that involves certain limitations (constraints) and goals. The goal in LP is usually to maximize profits or minimize costs, by utilizing limited resources. According to Taha (2011), LP is an optimization technique used to solve decision-making problems in conditions that involve a number of decision variables, linear objective functions, and linear constraints.

Method Simplex

The Simplex method is one of the techniques in Linear Programming that is used to solve optimization problems with more than two variables. This method was developed by George Dantzig and works iteratively to find the optimal solution of the objective function. The basic steps of the Simplex method include:

1. Define objective functions (e.g., maximize profits).
2. Arrange constraints in the form of linear equations.
3. Compile the Simplex table and iterate until the optimal value is obtained.

The Simplex method is more efficient than the graph method because it can be used to solve problems that have many variables and constraints.

Software POM-QM for Windows

POM-QM for Windows is a software used to help solve a variety of quantitative problems in the field of operations management and operations research. The software provides many modules, including a Linear Programming module that supports the Simplex method. The advantages of using POM-QM include:

1. Simplify mathematical calculations.
2. Delivers fast and accurate results.
3. Able to visualize the iteration process and final solution in the form of a table.

In the context of selling rolled shredded bread, POM-QM is used to optimize profits by considering production constraints such as raw materials, labor, and time.

Profit Analysis

Profit analysis is the process of evaluating how much profit can be obtained from a business activity by considering all components of costs and income. Profit can be calculated with the formula:

In this study, the analysis was carried out to determine the most profitable product combinations based on existing capacity and limitations.

Application of Linear Programming in Production

Linear Programming is often applied in production management to determine the optimal combination of products to obtain maximum profits. Taking into account the limitations of raw materials, labor, and production capacity, the LP method assists entrepreneurs in strategic decision-making.

METHODS

The steps in the research process are (Rico Ong et al., 2019) (Rumetna et al., 2018)

1. Identify the problem.
   The problem faced by the sale of rolled shredded bread products is maximizing profits with limited shipping costs and sales prices that must be adjusted.
2. Selection of problem solving models the model used in problem solving that has been identified is the Linear Program (PL) model of maximization problems using the simple method manually and using POM-QM analysis tools for Windows.
3. Data Collection
   Data collection is carried out through field studies such as observations, interviews, and documentation with employees of the product sales store in order to get data to be processed.

The data needed in this study is in the form of the price of shipping tickets, factory prices per each product, employee salary costs, production produced, and the

amount of production and product profits per production unit. The above steps can be clearly seen in Figure 1.

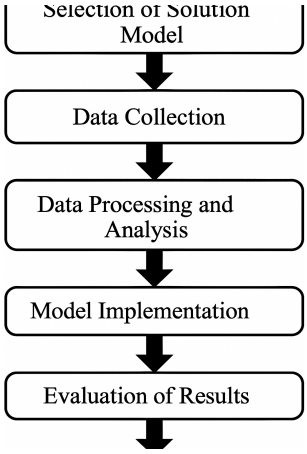


Figure 1. Research Flow Diagram

RESULT

Based on data from the sale of Hawaiian Rolled Shredded Bread, a grouping or identification of decision variables can be carried out, namely: *Beef Rolled Shredded Bread, requires: Bulk Item 40 box, Box Weight 48 kg, Beef Rolled Shredded Bread, requires: Lots of Goods 20 boxes, Box Weight 24 kg.*

Many goods are assumed that consumer demand corresponds to the number of sales. While the profit per product obtained is: Beef Rolled Shredded Bread Rp.180,000,-, Chicken Roll Shredded Bread Rp.170,000,- While the raw material Inventory is: Bulk Goods 100 boxes, Box Weight 120 kg kg. To determine the above formulation, the symbols X1, X2, and Z are used where: X1 = Beef Gulng Shredded Bread X2 = Chicken Glung Shredded Bread. Zmax = total profit of beef roll shredded bread and chicken rolled shredded bread. The purpose of selling shredded bread rolls is to get the maximum profit from the limitations they have. So the formulation of the mathematical model is: Maximizing Z = 180,000X1 + 170,000X2.

The limitations are formulated as follows (can also be seen in Table 1):

Table 1. Raw Materials, Product Types and Profit

Kendala	JenisProduk		Kapasitas
	Abon sapi	Abon ayam	
Banyak Box	40	20	100
Berat Box	48	24	120
Keuntungan (Rp)	180.000	170.000	

Table 1 data can be made to solve the maximum PL problem, the steps to solve it are as follows:

1. $40X1 + 20X2 \leq 100$

40X1 + 20X2 = 100

2. 48X1 + 24X1 ≤ 120

48X1 + 24X1 = 120

The function of the destination is changed to:

Z – 180.000X1 – 170.000X2 = 0

1. 40X1 + 20X2 ≤ 100 changed to

40X1 + 20X2 + S1 = 100

2. 48X1 + 24X1 ≤ 120 changed to

48X1 + 24X1 + S2 = 120

The above equations are arranged into a simplex table to find out the formulation of the problem (see Table 2):

Table 2. Formulation

Var	Z	X1	X2	S1	S2	NK
Z	1	-180000	-170000	0	0	0
S1	0	40	20	1	0	100
S2	0	48	24	0	1	120

Select a key column, i.e.: the one that has the values on the line of the goal function that have a negative value with the largest number (see Table 3):

Table 3 Key Columns

Var	Z	X1	X2	S1	S2	NK
Z	1	-180000	-170000	0	0	0
S1	0	40	20	1	0	100
S2	0	48	24	0	1	120

* Key Columns

Since the value of X1 is the highest negative number, which is -180000, column X1 is the pivot column and X1 is the entry variable.

1. **Select the key row, i.e.: the value that has the ratio limit to the smallest number (see Table 4).**

Limit Ratio = right value/key column value NK = right value

Table 4. Key lines

Var	Z	X1	X2	S1	S2	NK	Limit Rasio
Z	1	-180000	-170000	0	0	0	
S1	0	40	20	1	0	100	5/2
S2	0	48	24	0	1	120	5/2

X1= Key Column S1 = Key Row

The limit ratio is the result of the division between the right value and the value of the key column. The smallest right-hand value division ratio is 1.2.

2. Change the value on the key line

The first value is the value of the new pivot line which is X1, all values on the S1 line are divided by 40 (pivot elements).

Information:

a) Key line value / key number
b) Key value is: the value on line S1
   1) $\frac{0}{40} = 0$
   2) $\frac{40}{40} = 1$
   3) $\frac{20}{40} = 1/2$
   4) $\frac{1}{40} = 1/40$
   5) $\frac{0}{40} = 0$
   6) $\frac{100}{40} = 5/2$

In iteration 1, the result of the division is entered on a new row i.e. X1 where row S1 is changed to row X1 (see Table 5).

Table 5. Key Line Changes

Var	Z	X1	X2	S1	S2	NK
Z						
X1	0	1	1/2	1/40	0	5/2
S2						

Changing values other than on the key row.

New row = old row – (coefficient per key column * key row value).

Information:

a) Old row= Z row, and S2 row
b) The coefficients per key column are: -180,000 and 48
c) Keyline value= value on new keyline (X1)

Row value calculation: Z Line

Z	-180000	-170000	0	0	0
X1	1	1/2	1/40	0	5/2

The results of the new line are:

a) $-180{,}000 - (-180{,}000 * 1) = 0$
b) $-170{,}000 - (-180{,}000 * 1/2) = -80000$
c) $0 - (-180{,}000 * 1/40) = 4500$
d) $0 - (-180{,}000 * 0) = 0$
e) $0 - (-180{,}000 * 5/2) = 450000$

Results of calculation of new row values (Z)

Z	0	-80000	4500	0	450000

Line s2

S2	48	24	0	1	120
X1	1	1/2	1/40	0	5/2

The results of the new line are:

a. $48 - (48 * 1) = 0$

b. $24 - (48 * 1/2) = 0$

c. $0 - (48 * \frac{1}{40}) = -6/5$

d. $1 - (48 * 0) = 1$

e. $120 - (48 * 5/2) = 0$

Results of calculation of new line values (S2)

S2	0	0	-6/5	1	0

Enter the new row's value into the table (see Table 6).

Table 6. Changes to New Line Values

Var	Z	X1	X2	S1	S2	NK	Limit Rasio
Z	1	0	-80000	4500	0	450000	
X1	0	1	1/2	1/40	0	5/2	
S2	0	0	0	-6/5	1	0	

Then make improvements in steps (3-6) so that the rows in column Z have no negative value.

1. Selecting a key column

   Can be seen (in Table 7).

Table 7. Key Columns

Var	Z	X1	X2	S1	S2	NK
Z	1	0	-80000	4500	0	450000
X1	0	1	1/2	1/40	0	5/2
S2	0	0	0	-6/5	1	0

2. Selecting a lock line

   It can be seen (in Table 8).

Table 8 Key Rows

Var	Z	X1	X2	S1	S2	NK	Limit Rasio
Z	1	0	-80000	4500	0	450000	
X2	0	1	1/2	1/40	0	5/2	5
S2	0	0	0	-6/5	1	0	∞

3. Change the value on the key line

1) $\frac{0}{1/2} = 0$

2) $\frac{1}{1/2} = 2$

3) $\frac{1/2}{1/2} = 1$

4) $\frac{1/40}{1/2} = 1/20$

5) $\frac{0}{1/2} = 0$

6) $\frac{5/2}{1/2} = 5$

In iteration 2, the result of the division is entered into a new row i.e. X2 where row X1 is changed to row X2 (see Table 9).

Table 9. Lock line changes

Var	Z	X1	X2	S1	S2	NK
Z						
X2	0	2	1	1/20	0	5
S2						

4. Changing values other than on the key row.

Z Line

Z	0	-80000	4500	0	450000
X2	2	1	1/20	0	5

The results of the new line are:

a) $0 - (-180000 * 2) = 160000$
b) $-180000 - (-180000 * 1) = 0$
c) $4500 - (-180000 * 1/20) = 8500$
d) $0 - (-180000 * 0) = 0$
e) $450000 - (-180000 * 5) = 850000$

Results of calculation of new row values (Z)

Z	160000	0	8500	0	850000

Line s 2

S2	0	0	-6/5	1	0
X2	2	1	1/20	0	5

The result of the new line is :

a. $0 - (0 * 2) = 0$
b. $0 - (0 * 1) = 0$
c. $-\frac{6}{5} - (0 * \frac{1}{20}) = -6/5$
d. $1 - (0 * 0) = 1$
e. $0 - (0 * 5) = 0$

Results of calculation of new line values (S2)

S2	0	0	-6/5	1	0

Then the iteration table is shown in the table below. The calculation of the 2nd iteration table is optimal, so the calculation is stopped after the values in the objective function (Z) are all positive (can be seen in Table 10).

Table 10. Optimization Results

Var	Z	X1	X2	S1	S2	NK	Limit Rasio
Z	1	160000	0	8500	0	850000	
X2	0	2	1	1/20	-0	5	
S2	0	0	0	-6/5	1	0	

Based on the table above, the Z line no longer has a negative value so that the solution obtained is optimal, so the maximum profit obtained from the sale of rolled shredded bread from the calculation using the simplex method is Rp.850,000,- production every day. *Here are the steps to solve PL using the POM-QM For windows tool version 3.0.* When the program is active, it will be automatically redirected to the module menu, for the Pl problem, then select the linear programming module (see Figure 2).

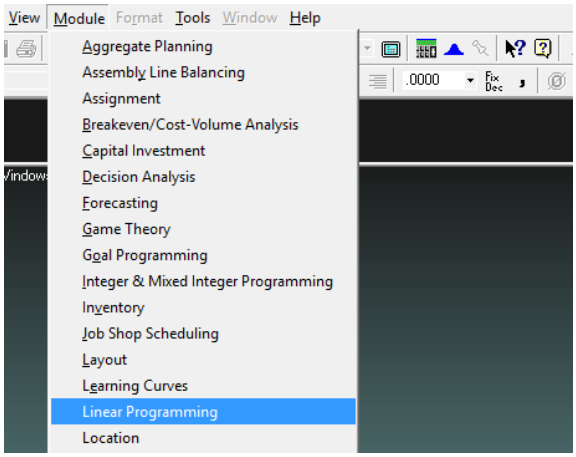


Figure 2. Module Selection Display

Then to create a new file, select

File→New (see Figure 3).

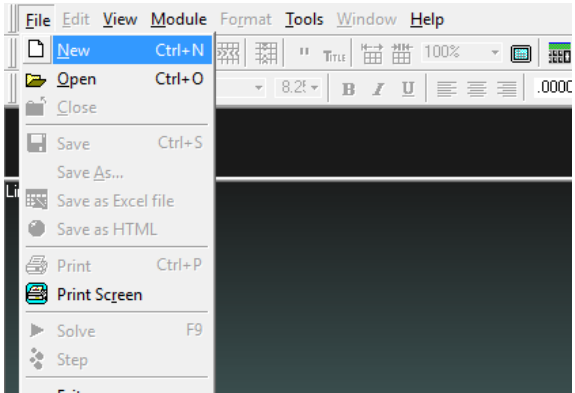


Figure 3. Create New File View

Then give input to the file for the data to be processed, such as the title, the number of constraints/constraints, the number of decision variables, the row name, and the column name. On this program

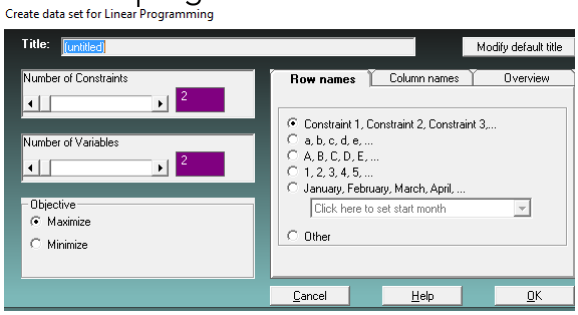
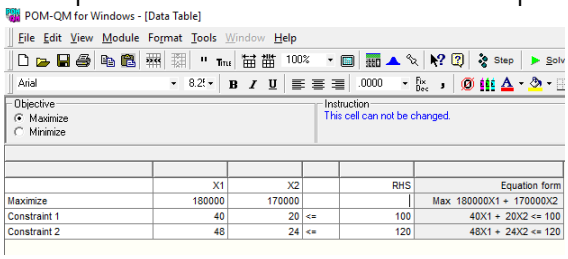


Figure 4. Linear Programming Data Input Display

After that, enter the production data into the fields provided (see Figure 5).



	X1	X2		RHS	Equation form
Maximize	180000	170000			Max 180000X1 + 170000X2
Constraint 1	40	20	<=	100	40X1 + 20X2 <= 100
Constraint 2	48	24	<=	120	48X1 + 24X2 <= 120

Figure 5. Production Data Input Display

After the data is finished entering, then select the solve button and then select the Iterations menu. Then a solution to solve the linear programming problem with the Simplex method will be obtained (see Figure 6).

Cj	Basic Variables	180000 X1	170000 X2	0 slack 1	0 slack 2	Quantity
Iteration 1						
	cj-zj	180.000	170.000	0	0	
0	slack 1	40	20	1	0	100
0	slack 2	48	24	0	1	120
Iteration 2						
	cj-zj	0	80.000	-4.500	0	
180000	X1	1	0,5	0,025	0	2,5
0	slack 2	0	0	-1,2	1	0
Iteration 3						
	cj-zj	-160.000	0	-8.500	0	
170000	X2	2	1	0,05	0	5
0	slack 2	0	0	-1,2	1	0

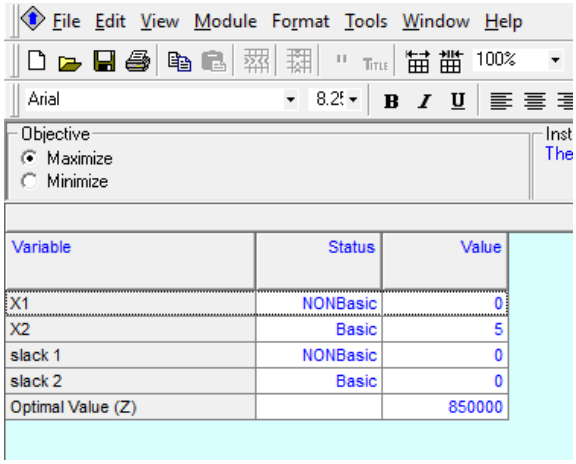


Figure 6. Solution View

The results of the analysis show that the application of PL using the POM-QM for Windows tools in optimizing the sales of rolled shredded bread can in calculating the maximum profit from the sales of Beef and Chicken Rolls Shredded Bread. The results of the analysis by applying the PL model with the simplex method, the maximum profit that can be obtained from the sale of rolled shredded bread is Rp 850,000 per production every day

CONCLUSION

Based on this discussion the conclusions that can be drawn are, the Linear Program in this case the simplex method can be used by the sale of Hawai Bakery rolled shredded bread. So that with the limited resources I have, it can be used to get maximum profits. The use of information technology, namely the POM-QM for windows tool, is very helpful in calculations because it is fast, precise and accurate (efficient). The simplex method can be used as a mess in decision-making, because it accelerates the sale of Hawai Bakey rolled shredded bread to innovate in producing products.

LIMITATION

Data Limitations

Limited Historical Data: Analysis often only uses short-term data, so the results do not necessarily reflect the long-term situation. Fixed Price Assumption: In many studies, raw material prices and selling prices are assumed to be fixed, when in reality they can change. Not Considering Seasonality: Demand for bakery products can be seasonal, but is not always taken into account in the model.

Limitations of the Linear Programming (Simplex) Model

Linearity Assumption: The Simplex model assumes a linear relationship

between variables (for example between production volume and profit), when in reality it can be non-linear. Not Taking Risk or Uncertainty into Account: Simplex does not take into account uncertainty in raw material supply, price fluctuations, or changes in market demand. One Optimization Objective: This method only optimizes one objective (for example maximum profit), without considering trade-offs with other objectives such as quality or production time.

Limitations of POM-QM Software

Limited Capabilities for Complex Cases: POM-QM is designed for simple to medium cases; it is not ideal for highly complex or dynamic cases. Not Integrated with Real-Time Systems: POM-QM is static; the analysis results cannot automatically adjust to changes in real-time data. Lack of In-depth Visualization and Sensitivity Analysis Features: The software has limitations in analyzing the impact of parameter changes on the optimal solution in depth.

Limitations of Research Scope

Does Not Analyze Marketing or Distribution Aspects: Focuses only on production and profits, without considering sales and distribution strategies. Does Not Account for Non-Linear Production Capacity: Machines or labor may not operate constantly; this is often overlooked in the model. Limited Generalization: Study results may only be relevant to a particular business or location, and cannot be generalized to all industries.

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