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Solving the Problem of Profit Maximization in Najwa Sewing House Textile Business in Salatiga

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Abstract. Linear programs are often referred to as linear problem-solving methods, one of which is the simplex method. A simplex method is an approach that the author can use in solving a linear program problem in determining the optimal solution that has two or more decision variables where determining the combination itself can be repeated, iterating over the simplex table until the optimum value is found in the optimization problem that has been studied. The business world must have optimization problems that include maximum profits and minimum costs, where both problems can be solved using the simplex method. The research began on May 14, 2023, at Najwa Sewing House (Clothing Store) Ngelosari, Jombor, Kec.Tuntang, Semarang Regency. This study aims to describe and analyze the simplex method in a linear program so that maximum profit is obtained in the production of Najwa Sewing House. The analysis carried out in this study uses the simplex method with calculations assisted by Excel applications. The results showed that the amount of optimum production from each product capacity at Najwa Sewing House resulted in a maximum profit of IDR 2.550.000.

Keywords: *House Sewing; Maximum Profit; Business; Simplex Method*.

1 Introduction

In the current era, the development of clothing production, especially in the fashion sector, continues to increase continuously. In order to survive in the current competitive era, business people must optimize results in producing their business. Small and Medium Enterprises (SMEs) are one of the businesses that have an essential role in developing the economy in Indonesia [1]. The production process is one of the essential factors in an open industry. Several influential factors in the textile production process make entrepreneurs have to go through inhibiting factors but can achieve maximum profits. Therefore, a business must be able to maximize the resources that are already available. The method used in this business will also affect the continuity, including the production process.

Operations research is a science currently widely used to help solve or solve problems related to the operational problems of a business [2]. Science in operations research is now widely applied by many business actors or businesses in running their business to solve operational problems and find an optimal solution in deciding on their business. Operations research is an application of methods, techniques, and scientific equipment to solve problems in business operations and find optimal solutions[3]. In the business world, a business person will always be faced with optimal problems, which include minimum costs or maximum value of a profit, by paying attention to existing constraints. One of the obstacles a businessman faces is the lack of available

resource capacity to produce optimal solutions and achieve a goal that has been set in the business. This operation research can solve applied problems using or utilizing linear programs. As time goes by, a business will experience problems determining the amount of production to continue producing maximum profits. There are many solutions to this problem, one of which is to use a linear program[4].

Mathematics today, is undeniable that many trigger various branches of science that are so useful for the survival of society, one of which is a linear program [5]. In the completion of linear programs, there are two methods: the simplex method and the graph method. According to Sitorus [6], A linear program is a general model in planning an activity to solve an allocation problem with limited resources optimally. A linear program is one of the mathematical models used to solve an optimization problem: to maximize or minimize the function of goals that depend on several decision variables [7]. Linear programming is one of the techniques in mathematics to solve problems to maximize or minimize something limited by certain limitations [8]. Understanding the graph method uses a graphing approach to determine the value of the optimum decision variable, but only on two decision variables. Meanwhile, use two or more decision variables. You can use the simplex method, where this method uses a simplex table approach, an effort to determine the value of the optimum decision variable obtained from repeatedly iterating to the simplex table until finding the optimum value sought.

As previously conducted by research [9], The simplex method is used in determining the optimal amount of ice teler and ice banana ijo production so that maximum profit is obtained so that the author uses the help of the application in efficient calculations. The research was also conducted by [10] that data analysis techniques using linear programs of the simplex method can optimize profits with raw material constraints on entrepreneurs. Research using simplex methods and assisted by ms excel applications have been carried out by [11] In analyzing the optimization of ready mix concrete production with the simplex method. Thus, the author aims to solve the problem of achieving maximum profit at Najwa Sewing House using the simplex method, which begins with interviews and observations first.

As previous research has explained, the rubber supply chain consists of two channels: KUB and non-KUB. The Joint Business Group is one of the organizations that contain farmers who have similar points of view and needs and can be used for a place in developing and implementing marketing activities. At the same time, non-KUB farmers who sell rubber results directly to intermediary traders [12].

Najwa Sewing House is one of the small-scale business actors in the textile sector located in the Ngelosari Jombor area, Tuntang District, Semarang Regency. Najwa Sewing House produces various stitch model products such as school uniforms, dresses, daisies, cadet coral uniforms, etc. Because the business developed by Najwa Sewing House is still classified as a small business, Najwa Sewing House conducts production planning only using estimates so that the owner cannot know precisely how many products must be produced optimally to get maximum profit. However, with limited fabric or raw materials availability, this is undoubtedly an optimization problem for the Najwa Sewing House business. The simplex method of finding the maximum profit value in production is one of the right solutions to solve the problem of Najwa Sewing House, which is constrained by materials but wants to achieve the maximum profit. Therefore, every company must develop and improve performance to achieve effectiveness and efficiency [13]. Everyone or entrepreneur must also be able to look for opportunities that exist to be able to compete in business and industry by looking at the opportunities that exist in the surrounding environment.

Business owners need to implement a suitable strategy to get maximum profit in production activities, especially in the production activities of Najwa Sewing House. In order to get optimum results, we can apply

linear programming, which is the simplex method. In this case, uniform production in large quantities can be maximized. Therefore, this study is intended to program in which the maximum profit in the production of Najwa Tailoring House can be obtained.

2 Methodology

This research applies the linear program method to find a maximum solution using the simplex method. The goal of this linear program with the simplex method is to get the optimal allocation of existing resources without any addition from outside to achieve optimal goals [14]. What is analyzed in this study is the problem of profit maximization. The research began on May 14, 2023, at Najwa Sewing House (Clothing Store) RT 03/RW 01 Ngelosari, Jombor, Kec.Tuntang, Semarang Regency. The population in this study is the small business of Najwa Sewing House in the textile sector, then the sample used in this study is Najwa Sewing House. The research instruments that the author uses are interviews and observations following the research theme.

2.1 The Data Collection Techniques

The data collection techniques used are by conducting field and literature research. In field research, the author collected the data needed and related to the research through interviews and observations to obtain production data of Najwa Sewing House. Meanwhile, in literature research, the author takes information related to the research theme through print and electronic media, such as articles and literature that are relevant and valid to this research.

2.2 The Data Analysis Techniques

The data analysis technique used in this study uses the simplex method through Excel-assisted calculations. The optimization problem to be solved is maximizing profits (maximization) in producing *games* and school uniforms. The simplex method is one approach to solving linear programming problems with two or more decision variables where determining the optimal combination is done through repeated iterations of the simplex table until the optimum value is found in the optimization problem, which includes maximizing profits or minimizing costs. The simplex method has the advantage of being able to solve linear programming problems with two or more decision variables.

3 Result And Discussion

In this study, the type of data analysis technique using a linear program used was the simplex method, but the data collection technique was observation and data interview. The data used is school uniform or wedding dress production data. The decision variable is the clothes produced by these MSMEs. Najwa Sewing House produces 2 types of clothes: school uniforms and wedding clothes. In the uniform production process, 3 meters of TC fabric and 1 meter of drill fabric are needed. Each production of this wedding dress requires 2 meters of TC fabric and 2 meters of drill fabric. So how much is the amount of clothing production so that Najwa Sewing House MSMEs can get maximum profits? The first step is to define the variables first.

There are two types of clothes produced as follows:
x : school uniform
y : wedding dress

This study aims to maximize production numbers with product prices as a coefficient of decision variables is the number of uniform units and gamis that Najwa Sewing House must produce. The Excel analysis and calculations found that to maximize the production results, they had to produce 25 uniforms and gamis.

Table 1. Production data

Fabric Material	School Uniform (X)	Wedding Dress (Y)	Maximum Capacity
TC Fabric	3 meters	2 meters	60
Fabric Drill	1 meter	2 meters	40
Shirt Price	IDR 75,000	IDR 120,000	

3.1 The Identification

Decision variable, namely the type of clothes produced by Najwa Sewing House. In this case, the decision variable is how many sets of school clothes should be produced and given the X symbol and how many sets of gamis wedding clothes should be produced and given the Y symbol. The coefficient used for the value of the objective function is the per-unit selling price of each type of product, and the Constraint function, namely the two primary fabric materials used to produce school uniforms and gamis clothes, including TC cloth and drill fabric.

3.2 The Resolution Steps

How to Identify objective functions and constraint functions?

The objective function in this case study is to maximize profits at a price per product unit as a coefficient of decision variables on the number of uniform school products that must be produced (X) and the number of units of clothing that must be produced (Y). The goal function is expressed in the form of a mathematical equation as follows:

Maximize $Z = 75.000X + 120.000Y$

The constraint function in this case study is the maximum capacity of the material to make clothes available in one production. The raw materials that are an obstacle are TC fabric (A) and drill fabric (B). The constraint function is expressed in the form of mathematical inequality as follows:

$$\textit{TC Fabric (A):}\ 3X + 2Y < 60 \quad (1)$$

$$\textit{Drill Fabric (B):}\ X + 2Y < 40 \quad (2)$$

How to Convert goal functions and constraint functions to implicit functions?

The goal function is converted into an implicit function, i.e., everything shifts to the left. While the constraint function is converted into an equation by adding a slack variable. Slack variables are given the symbols $S1, S2, \ldots, Sn$ according to the number constraints. Then the objective function and constraint

function:

$$Maximize\ Z - 75.000X + 120.000Y = 0 \quad (3)$$

Constraint Function :

$$TC\ Fabric\ (A) \quad : 3X + 2Y + S1 = 60 \quad (4)$$

$$Fabric\ Drill\ (B) \quad : X + 2Y + S2 = 40\ with\ X, Y, S1, S2 \geq 0 \quad (5)$$

How to Construct the Equations in The Simplex Table?

Table 2. Simplex Table

		Cj	**75000**	**120000**	**0**	**0**	
Cb	**Vbd**	**Q**	**x**	**y**	**S1**	**S2**	**Pen**
0	S1	60	3	2	1	0	
0	S2	40	1	2	0	1	
	Zj						
	Zj-Cj						

How to Define key columns, key rows, and critical elements?

Table 3. Columns, rows, and elements

		Cj	**75000**	**120000**	**0**	**0**	
Cbd	**Vbd**	**Q**	**x**	**y**	**S1**	**S2**	**Pen**
0	S1	60	3	2	1	0	30
0	S2	40	1	2	0	1	20
	Zj	0	0	0	0	0	
	Zj-Cj		-75000	-120000	0	0	

How to calculate Zj-Cj to determine key columns and key rows?

The destination function is maximization, and then the key column is the column of the most negative coefficient value in the row of the destination function Z in that column. It is known that the value of the coefficient with the most significant negative is (-120.000) then the key column is in column Y; The ratio value is obtained from the result of dividing between the correct value and each number corresponding to the critical column; Key rows are determined based on the row that has the smallest ratio value. In the table, it can be known that the smallest ratio value is 20, then the critical row is in row $S2$. The key element is obtained

from the intersection value between the critical column and row. The key element is worth 2, and thus the value of $S2$ on the key row is set as the exit variable and replaced by the value of Y, which acts as the entry variable.

How do we Change fundamental row values?

Table 4. Simplex table

		Cj	**75000**	**120000**	**0**	**0**	
Cb	**Vbd**	**Q**	**X**	**Y**	**S1**	**S2**	**Pen**
0	S1	20	2	0	1	-1	10
120000	Y	20	0,5	1	0	0,5	40
	Zj	2400000	60000	12000	0	60000	
	Zj-Cj		-15000	0	0	60000	

		Cj	**75000**	**12000**	**0**	**0**	
Cb	**Vbd**	**Q**	**X**	**Y**	**S1**	**S2**	**Pen**
0	S1	20	2	0	1	-1	10
12000	Y	20	0,5	1	0	0,5	40
	Zj	2400000	60000	120000	0	60000	
	Zj-Cj		-15000	0	0	60000	

We change the values in the previous table key row by transforming the row. After that, we change $S2$ to

Y because the variable $S2$ exits and is replaced by the value of Y, which acts as the entry variable.

How to Build Equations In a New Simplex Table?

TABLE 5. The Results Table

		Cj	**75000**	**120000**	**0**	**0**	
Cb	**Vbd**	**Q**	**x**	**y**	**S1**	**S2**	**Pen**
75000	X	10	1	0	0,5	-0,5	
120000	Y	15	0	1	-0,25	0,75	
	Zj	2550000	75000	120000	7500	52500	
	Zj-Cj		0	0	7500	52500	

The simplex table in Table 5 has achieved optimal results when each value in row Z (destination function) has no negative value (maximization case). In the new simplex table, the results of the first iteration above do not have negative values, so there is no need to improve the iteration in the simplex table. There is no need to redo it; it has achieved the maximum goal function.

Based on the simplex table above, we get the following:

X = 10 sets of school uniforms

Y = 15 sets of gamis

$Z = 75.000X + 120.000Y$

$Z = 75.000(10) + 120.000(15)$

$Z = 750.000 + 1.800.000$

$Z = 2.550.000$

The results of the calculation of linear program profit optimization using the simplex method obtained optimal results that to get maximum profit Najwa Sewing House, Salatiga must produce 10 sets of school uniforms and 15 sets of gamis so that the profit obtained is Rp 2.550.000 from the total sales in one product so that if Najwa Sewing House receives new clothing orders once a week, then the maximum profit accumulation in one month is Rp 10.200.000 of the total sales results.

This aligns with the research [1] that the simplex method can solve maximum problems with few constraints. Other research conducted on brick production companies also obtained maximum profits with minimum production costs [15]. The simplex method has been applied and obtained results [16] of maximum profit with minimum production costs in production activities.

4 Conclusion

Thus, the advantage of using the simplex method in a linear program to determine and maximize profits in production is essential so that the seller gets as much profit as possible with the inventory. The simplex method provides maximum profit with limited production materials. Suppose Najwa Sewing House produces 10 sets of school uniforms and 15 sets of gamis, so the profit obtained is Rp 2.550.000. So, Najwa Sewing House will get the optimum profits with a minimal set of clothes. Applying the simplex method in optimizing profit can assist the Najwa Sewing House in maximizing sales profits for clothing products from the resources that are owned and can give an inside picture of making decisions related to sales.

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