Optimizing Best-Selling Menu Production using the Linear Programming Method: Case Study on Lines Coffee

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ABSTRACT

This research aims to optimize the production of Lines Coffee to maximize profit through the application of the simplex method. Lines Coffee, a company in the food and beverage industry, features bestselling menu items such as Kopi susu gula aren, Americano, Latte, and Cappuccino. By employing the simplex method, this study seeks an optimal solution that satisfies production constraints and enhances the objective function, which is profit. The research findings indicate that the optimal solution involves producing 15 units of Americano while not producing Latte and Cappuccino. This solution yields a profit of IDR 28,000,000. Although the optimal solution suggests a focus on Americano production, Lines Coffee faces limitations in meeting market demand for Latte and Cappuccino. In conclusion, Lines Coffee may consider strategies to increase the production of Latte and Cappuccino to meet market demand. Additionally, efforts to reduce production costs could be key to further optimizing profits. This research contributes to understanding production strategies in the food and beverage industry, particularly in coffee shops.

Keywords*: Profit, Coffee Lines, Production optimization, Simplex method*

ABSTRAK

Penelitian ini bertujuan untuk mengoptimalkan produksi Lines Coffee guna memaksimalkan laba melalui penerapan metode simpleks. Lines Coffee, sebuah kedai coffee shop yang menjual makanan dan minuman, memiliki menu best seller seperti Kopi susu gula aren, Americano, Latte, dan Cappucino. Dengan menggunakan metode simpleks, penelitian ini mencari solusi optimal yang memenuhi kendala produksi dan meningkatkan nilai fungsi tujuan, yaitu laba. Hasil penelitian menunjukkan bahwa solusi optimal adalah memproduksi 15 unit Americano sementara tidak memproduksi Latte dan Cappucino. Solusi ini menghasilkan laba sebesar Rp 28.000.000. Meskipun solusi optimal menyarankan fokus pada produksi Americano, Lines Coffee dihadapkan pada keterbatasan untuk memenuhi permintaan pasar terhadap Latte dan Cappucino

Kata kunci*: Laba, Lines Coffee, Optimalisasi produksi, Metode simpleks*

INTRODUCTION

The coffee shop industry in Indonesia is progressing rapidly, reflected in the diversification of concepts and an increase in the number of outlets. Coffee shops in Indonesia are no longer limited to traditional formats, but have evolved into an ecosystem that encompasses all kinds of concepts, from coffee shops faithful to local heritage to modern shops with eye-catching contemporary designs (Foedinatha & Hartanto, 2021). Along with this growth, the coffee shop industry has become a place for a variety of experiences and lifestyles, attracting customers from different walks of life. Based on Toffin's independent research in Maruli, N., & Sari, D. (2023), the number of coffee shops in Indonesia as of August 2019 reached more than 2,950 outlets, an increase of almost three times compared to 2016, which was only 1,000 outlets. Where the market value generated reached IDR 4.8 trillion (Toffin, 2019).

The popularity of Indonesian coffee shops has attracted the attention of local and international players, creating increasingly fierce competition. In the face of this challenge, coffee shops not only compete in terms of brand, but also product quality. The importance of production optimization is a critical aspect in maintaining the competitiveness of *coffee shops*, especially in relation to their *best seller* menus. The menu that is most in demand by customers is often the main foundation for *coffee shops* in retaining and attracting new customers. Therefore, optimizing the production process of mainstay menus is a strategic step (Krismanto.R.E., 2019).

In this context, production efficiency is not only limited to pursuing quantity, but also maintaining product quality. *Coffee shop* owners need to ensure that the raw materials used are the best and up to standard. An efficient and organized production process can minimize customer waiting time, increase throughput, and ensure the availability of *best seller* menus without compromising quality standards (Setiawan and Nugroho, 2023).

The results of research by Sulistyo and Setiawan (2022) also show that the use of technology in production optimization is also a determining factor. Digital ordering systems, automatic coffee makers, and smart stock management can help *coffee shops* improve operational efficiency. With these technologies, *coffee shops* can provide a fast and efficient customer experience without sacrificing the quality of the end result.

Lines Coffee in Ruko U-Town, South Tangerang City, is a *coffee shop* that was established because it saw considerable consumer potential in the surrounding location. The location is quite strategic right in front of a campus of Universitas Pembangunan Jaya, making the main consumers at Lines Coffee are students. However, recently the emergence of similar business competitors in the vicinity has made Lines Coffee management itself have to create optimization on the production and sales side as well as possible so that this *coffee shop* can survive. This is a challenge for Lines Coffee to maintain its existence, therefore we try to increase sales on the *best seller* menu, namely there are 4 menus, from this menu we want to maximize *profits* using the *Linear Programming program.*

This study aims to examine and analyze production optimization at Lines Coffee with a focus on their best seller menu. The first problem statement includes a strategy on how to maximize the profit of Lines Coffee by increasing the sales of the best seller menu through the application of Linear Programming. This research will seek the best solution to determine the number of best seller menu sales that Lines Coffee can achieve in order to maximize profits. The second problem statement highlights the importance of prioritizing best seller menu sales to achieve optimal profitability goals. The objective of this research also includes developing a method to determine the order of sales that can contribute the most to Lines Coffee's profit. The third problem statement explores how to effectively manage Lines Coffee's production in order to maintain stability between production and demand. This research aims to develop methods that can improve production efficiency and accommodate fluctuations in customer demand, so that Lines Coffee can remain competitive and respond to the market more adaptively.

LITERATURE REVIEW

Production

Production is an activity carried out by humans to create goods or services to meet needs (Rapaccini et al., 2020). According to the definition put forward by Krajewski et al. (2023), production is a complex process that converts various resources, such as raw materials, labor, capital, and technology, into products that are ready for use or consumption by society. This process includes not only physical transformation, but also the integration of these elements to produce added value.

Production, according to Assauri (2011), is the main element in meeting human needs. This activity has a central role in transforming elements such as raw materials, labor, and capital into goods or services that not only meet basic needs, but also add value. Thus, production is not only limited to the physical act of creating a product, but is a creative process that involves a variety of factors that contribute to improving the quality of human life.

Optimization

Optimization is a process that aims to achieve ideal results or achieve effective values that can be achieved (Yang & Shami, 2020). According to Nurrohman (2017), optimization involves efforts to improve performance in a work unit or individual related to the public interest, with the aim of achieving optimal results. A similar opinion was also conveyed by Huda (2018), who stated that optimization is a process to optimize something, or in other words, to make something the best or highest.

Tuy et al. (2019), suggested several other concepts regarding optimization. First, optimization is defined as the process of finding the best value of an objective function by considering existing constraints. Second, optimization is described as the process of finding the best solution to a problem by considering the inherent costs and benefits. Finally, optimization is defined as the process of finding the best solution to a problem by considering the risks and benefits involved. Through these definitions, emphasis is given to different aspects of optimization, such as the objective function to be optimized, the constraints that affect possible solutions, and the *trade-offs* between costs and benefits or risks and gains that must be taken into account in decision-making.

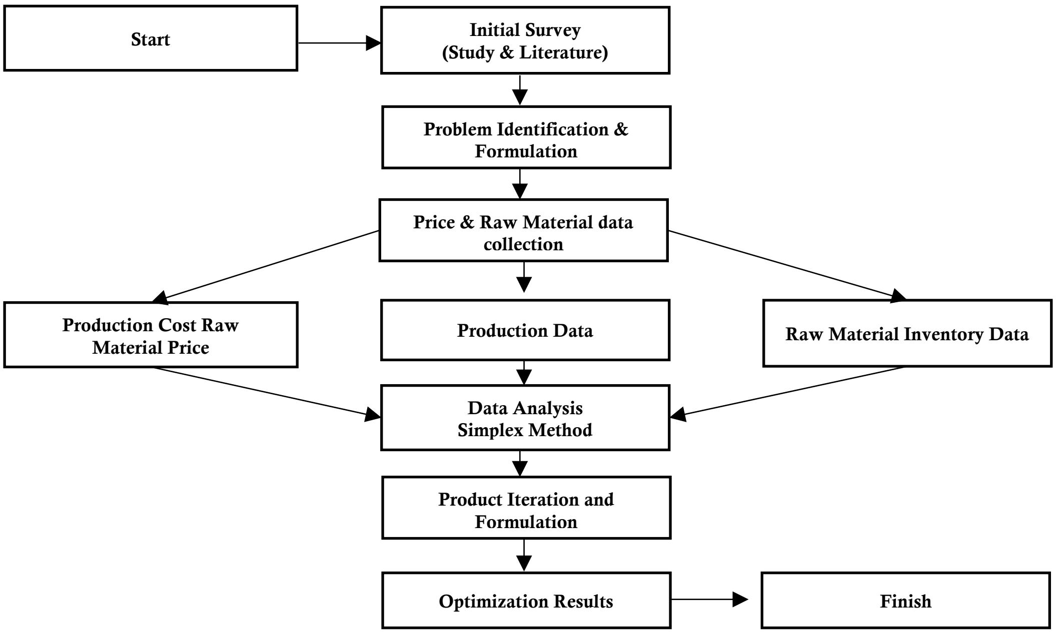
Linear Programming

Linear Programming is a mathematical method used to find the optimal solution to an optimization problem expressed in the form of equations and linear inequalities (Garajová et al., 2019; Pérez-Cañedo, B., & Concepción-Morales, 2019; Vanderbei, 2020). Hillier and Lieberman (2014) state that *Linear Programming* is a technique for solving optimization problems by utilizing equations and linear inequalities. According to Taha (2010), *Linear Programming* is a technique used to find the optimal solution to an optimization problem using a linear objective function and linear constraints.

The simplex method is an iterative method for solving *Linear Programming* problems that uses simplex tables to represent solutions and constraints (Lidia, 2020; Pardeshi & Gawade, 2022; Visuthirattanamanee et al., 2020). A simplex table is a table used to represent the solution and constraints of a *Linear Programming* problem (Khaidarova, 2022). Basic variables are variables whose values are already known in the initial iteration. Non-basic variables are variables whose values are still unknown at the initial iteration (Zhuo et al., 2019).

METHODS

This research was conducted at Lines Coffee located in U-Town Bintaro Shophouse, South Tangerang City. This research is structured as quantitative research with an analysis that adopts an optimization analysis method using a simplex linear programming model. The data required in this research is quantitative, obtained through information or explanations put forward by respondents through observations and interviews, and then expressed in the form of numbers or numbers. In the data collection stage, observations and interviews were conducted to obtain information related to daily coffee production data. The main focus of this research is to explore the maximum profit potential at Lines Coffee, with an emphasis on the *best seller* menu available. The research method used in this article can be summarized in the form of a *flowchart* shown in Figure 1.



Source: *Data processed (2023)*
Figure 1. Flowchart of Thought

RESULTS

Linear Programming Calculation

In this research, problem solving is done using the Linear Programming method, which is structured with decision variables, objective functions, and constraint functions. The decision variables in this context include the three main types of products produced by the company. The objective function is designed to achieve maximum profit, taking into account the profit of each type of product. Table 1 shows the 4 *best seller* menus*,* along with the prices available at Lines Coffee.

Table 1. Best Seller Lines Coffee Menu

Best Seller Menu	Price
Aren Sugar Milk Coffee	22.000
Americano	26.000
Latte	27.000
Cappuccino	28.000

Source: *Data processed (2023)*

The variables determined in this study can be shown through the formulation of data on the simplex *linear programming* method into a mathematical model and formulated in the form of objective functions and constraint functions. Table 2 shows a *Linear Programming* Model for Coffee Production on the *Best Seller* menu at Lines Coffee.

Table 2. Linear Programming Model for Coffee Production

Type of Coffee	X1	X2	X3	X4	RHS
Maximize	22000	25000	27000	21000	6000000
Espresso	25	25	25	25	6000000
Creamer	15	15	20	25	0
Mineral Water	20	25	20	25	6000000
Greenfield Milk	0	0	0	0	0
Aren Sugar	0	0	0	0	0
Sugar	0	0	0	0	0

Source: *Data processed (2023)*

The table shows that each best seller menu sold by Lines Coffee has six types of ingredients to produce, namely *Espresso*, *Creamer*, Mineral Water, *Greenfield* Milk, Gula

Aren, and Sugar. The decision variables X1, X2, X3, and X4 represent the number of units of each type of coffee produced. The objective of the model is to maximize the total profit of the company, which is measured in unspecified units, but expressed on the line "*Maximize*."

Decision Variable

The decision variables in this problem include four types of coffee, namely *Americano* (X2), *Latte* (X3), Aren Sugar Milk Coffee (X1), and *Cappuccino* (X4). Each variable represents the amount of coffee production per month.

1) X1 = Quantity of palm sugar milk coffee produced/month
2) X2 = Number of *Americano* produced/month
3) X3 = Number of *Lattes* produced/month
4) X4 = Number of *Cappuccinos* produced/month

Objective Function

The objective function (Z) is based on the profit of each type of coffee produced by Lines Coffee. The main objective is to maximize the total profit. The objective function is formulated as follows:

$$Z = 22{,}000X1 + 26{,}000X2 + 27{,}000X3 + 28{,}000X4 + 0S1 + 0S2 + 0S3 + 0S4$$

This function reflects the total amount of profit that can be earned from the production of Aren Sugar Milk Coffee (X1), *Americano (*X2), *Latte (*X3), and *Cappuccino* (X4), with the surplus variables (S1, S2, S3, S4) being zero in this context.

Constraint Function

The constraint function reflects the restrictions that must be adhered to in the production of each type of coffee. These constraints involve raw material supply, market demand, and production capacity. The constraint function is formulated as follows:

1) $25X1+20X2+25X3+20X4<60.000.000$
2) $15X1+X2+X3+X4<390.000$
3) $20X1+20X2+20X3+20X4<10.000.000$
4) $150X1+X2+150X3+150X4<50.000.000$
5) $15X1+X2+X3+X4<390.000$
6) $X1+X2+10X3+X4<350.000$

This constraint function covers critical aspects of production, including raw material inventory, market demand, and production capacity for each type of coffee. Ensuring that each constraint is met is key to achieving an optimal solution in the context of profit maximization.

Data Analysis with QM for Windows

Calculation at Iteration 1

The first iteration of the Simplex method gives an idea of the analysis results in the table. In the first iteration, the objective function value, which represents the maximum profit, was found to be 15. This was calculated by summing up the profit contributions of the base variables, namely x2 and x3. Although the resource availability and market demand constraints for palm sugar milk coffee were met, the constraints for *Americano* and *Cappuccino* were not. Nonetheless, the objective function value is still greater than the production cost, indicating the potential for increased profit. The following calculation results for iteration 1 are in Table 3.

Table 3. Iteration 1 Results

Column	Description	Value
Z	Objective function	15
x1	Quantity of palm sugar milk coffee produced/month	0

x2	Quantity of Americano produced/month	3
x3	Number of Lattes produced/month	2
x4	Number of Cappuccinos produced/month	1

Source: *Data processed (2023)*

The base variables in the first iteration are x1 and x2, while the non-base variables are x3 and x4. In this context, the *enter* variable is x3, which will be the base variable in the next iteration, while the *leave* variable is x1. By looking at the ratio value, it can be identified that the x2 variable can be increased by 2.5 times if the base variable is replaced with the *enter* variable. However, since the ratio value must be smaller or equal to 1, the market demand constraint for *Americano* cannot be met in the first iteration.

In conclusion, the solution in the first iteration is not optimal because it does not meet all market demand constraints. Therefore, a second iteration is required to increase the value of the objective function and achieve a more optimal solution.

Calculation on Iteration 2

The second iteration of the simplex method for the coffee shop production optimization problem presented significant results. In the simplex table, the objective function, which in this context is profit, reaches a value of 25. This value is obtained through calculations involving base variables, such as Number of *Lattes* (x3), which is now 2.5 units. The calculation results for iteration 2 are shown in Table 4.

Table 4. Iteration 2 Results

Column	Description	Value
Z	Objective function	25
x1	Quantity of palm sugar milk coffee produced/month	0
x2	Quantity of Americano produced/month	0
x3	Number of Lattes produced/month	2,5
x4	Number of Cappuccinos produced/month	0

Source: *Data processed (2023)*

The ratio calculation shows that an increase in the quantity of Cappuccino (x4) can make a significant contribution to profit. However, the limitation of the ratio value implies that such an increase cannot be made without violating the market demand constraint for *Americano*. However, an eye-catching result is the improvement in the objective function value compared to the previous iteration. The profit earned is now greater than the cost of production, indicating improved efficiency and profitability.

Thus, the second iteration of the simplex method produces an optimal solution for *coffee shop* production, ensuring a balance between market demand, resource availability, and profit maximization. Innovation and efficiency in production strategy are key to maintaining the competitiveness and sustainability of the *coffee shop* business in the midst of increasingly fierce competition.

Based on the results of iterations 1 and 2, the optimal solution to the production optimization problem is to produce 15 units of *Americano* and 0 units of *Latte* and *Cappuccino*. This solution generates a profit of IDR 28,000,000. In iteration 1, the solution obtained was to produce 0 units of palm sugar milk coffee, 3 units of *Americano*, 2 units of *Latte,* and 1 unit of *Cappuccino*. This solution did not meet all the constraints, namely the market demand constraints for *Americano* and *Cappuccino*. Therefore, a second iteration was conducted to increase the value of the objective function and fulfill all constraints.

In iteration 2, the base variables are changed from x1 and x2 to x2 and x4. This causes the x2 variable value to increase by 15 units, while the x1 variable value remains 0 units. The optimal solution obtained in iteration 2 is to produce 15 units of *Americano* and 0 units of *Latte* and *Cappuccino*. This solution satisfies all constraints and the value of the objective function cannot be increased anymore.

The results of the optimal solution analysis show some critical aspects that Lines Coffee needs to consider. In terms of production, it is recommended that the company focus on producing more Americano and stop producing Latte and Cappuccino, as Americano has a higher selling price. However, it should be noted that this solution could potentially not meet the market demand for Latte and Cappuccino, which stands at 10 units each. Although this solution resulted in a profit of IDR 28,000,000, there is an opportunity for further profit improvement by finding ways to fulfill the unmet market demand for Latte and Cappuccino. Therefore, the company can explore additional strategies to optimize production and increase profitability, while keeping an eye on the evolving dynamics of market demand.

In general, the optimal solution obtained from the simplex method is the one that satisfies all constraints and produces the largest objective function value. However, it is also necessary to consider other factors, such as market demand and production costs, to determine the most optimal solution.

CONCLUSION

Based on the research results, it can be concluded that the Simplex method is effectively used to solve production optimization problems with the aim of maximizing profits. The optimal solution generated in the second iteration shows that Lines Coffee's optimal production is to produce 15 units of *Americano*, 0 units of *Latte,* and 0 units of *Cappuccino*, resulting in a profit of 25. This optimal solution meets all constraints of resource availability and market demand for palm sugar milk coffee, *Latte*, and *Cappuccino*. In addition, the solution cannot be improved anymore, indicating that the company has reached the maximum profit level with the existing conditions and constraints.

The suggestions focus on increasing *Latte* and *Cappuccino* production to meet market demand and reducing production costs to increase profits. By implementing these suggestions, it is expected that the company can achieve higher efficiency in its operations and can better meet market needs. The results also provide answers to the research questions, namely how to maximize the profit of Lines Coffee and determine the sales priority of the *best seller* menu. The optimal solution shows that the production of more *Americano* than *Latte* and *Cappuccino* corresponds to a higher selling price for *Americano*.

Thus, this research contributes to the optimization of the production strategy of coffee companies and provides an overview of the application of the Simplex method in the context of production optimization.

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