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Optimising Profits Using the Two-Phase Method and Sensitivity Analysis of UMKM Kedai Ibu

Faryz Reynaldy[1*], Winarno[1], Maria Angela Putri Setyawati[1], Deviana Nauli Bernadeta[1]
[1] Teknik industri, Fakultas Teknik, Universitas Singaperbangsa Karawang, Jl H.S. Ronggowaluyo Puseur jaya, Telukjambe Timur, Kabupaten Karawang, 41361, Indonesia
E-mail: faryzreynaldy08@gmail.com

Abstrak

Kedai Ibu merupakan Usaha Mikro, Kecil, dan Menengah (UMKM) yang bergerak di bidang kuliner rumahan. Dalam menjalankan operasional bisnisnya, Kedai Ibu menghadapi tantangan dalam menentukan optimasi produksi untuk memaksimalkan keuntungan dengan sumber daya yang terbatas, seperti bahan baku dan waktu produksi. Permasalahan optimasi sering kali melibatkan dua tujuan utama, yaitu memaksimalkan keuntungan atau meminimalkan biaya. Metode yang digunakan dalam penelitian ini adalah metode dua fase (two-phase method) dan analisis sensitivitas, yang dilakukan melalui perhitungan manual serta dibantu oleh perangkat lunak Lingo.Tujuan penelitian ini adalah untuk mendeskripsikan dan menganalisis penerapan program linear dengan metode dua fase guna mencapai keuntungan produksi maksimal. Hasil penelitian menunjukkan bahwa jumlah keuntungan yang diperoleh adalah Rp1.157.000 dengan memproduksi 250 porsi Ayam Geprek dan 50 porsi Ayam Bakar dalam setiap pesanan sebanyak 300 porsi ayam.

Kata kunci: *analisis sensitivitas, dua fase, maksimasi keuntungan, program linier.*

Abstract

Kedai Ibu is a Micro, Small, and Medium Enterprise (MSME) engaged in home cooking. Business operations run by Kedai Ibu face challenges in determining production optimisation to maximise profits with limited resources, such as raw materials and production time. Optimisation problems often involve two main objectives, namely maximising profits or minimising costs. The research method employed is the two-phase method, with sensitivity analysis conducted through manual calculation and assisted by Lingo software. The purpose of this research is to describe and analyse the implementation of linear programming using the two-phase method to achieve maximum production profit. The research results indicate that the profit obtained is IDR 1,157,000, achieved by producing 250 portions of Ayam Geprek and 50 portions of Ayam Bakar for each order of 300 chicken portions.

Keywords: *linear programming, profit maximisation, sensitivity analysis, two-phase*

1. Introduction

Operations research is now a commonly used tool in solving operational-related problems in various fields, especially in business. The main objective of operations research is to find optimal solutions in organisational decision-making. In the business context, every business faces optimisation challenges, such as minimising costs or maximising profits, while considering various existing constraints. One example is considering the limited capacity of available resources to achieve the desired business goals. In this case, operations research plays an important role in finding the optimal solution.

A commonly used method to solve optimisation problems is linear programming (Budiyanto, 2020). This model involves maximising or minimising an objective function by considering the decision variables involved (Wijayanti, 2024).

According to Desyana (2024), optimisation is the process of finding the best solution to a problem using a mathematical model, the solution of which can be obtained through various methods such as linear programming, nonlinear programming, multiple objective programming, and other methods.

According to Budi Halomoan S. and Abil Mansyur (2020), linear programming is generally defined as a method for solving optimisation problems by modelling them as objective functions and constraints, both of which are linear. The linear program function is divided into two. First, the objective function is an analysis that determines the purpose of formulating the problem that occurs. And second, the constraint function, which serves to review existing resources and demand for the reviewed resources (Hartama, 2020).

There are two common methods used in linear programming, namely the graphical method and the

[1*] Faryz Reynaldy
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simplex method. The graph method uses a graphical approach to determine the optimum value of a problem involving two decision variables. However, this method is only applicable to cases with two decision variables (Wijayanti, 2024).

The linear programming model comprises three main aspects: decision variables, which are problem variables that affect the objective value to be obtained. (Indah, 2020). The objective function is the goal to be obtained, which must be realised through a linear mathematical formulation. (Febriyanti, 2021). Functional constraints are the problems contained in the problem that will be put into a mathematical formulation.

Kedai Ibu is one of the small-scale food businesses located in the Telukjambe area, Karawang Regency. Kedai Ibu sells a variety of foods, with the best-selling main menu being Ayam Geprek (smashed fried chicken with sambal) and Ayam Bakar (grilled chicken, Indonesian style). In planning for ordering Ayam Geprek and Ayam Bakar, Kedai Ibu uses estimates only, which prevents the owner from optimising profits based on the raw materials used and the time spent making chicken orders to maximise profit. This presents a clear optimisation problem for Kedai Ibu, where business actors must develop a production strategy to maximise profits from each order.

Kedai Ibu needs to optimise the number of orders on the food menu, especially for Ayam Geprek and Ayam Bakar, to maximise profit. This can be achieved through alternative linear programming, specifically the two-phase method.

The two-phase method is a technique in linear programming that optimises problems involving a large number of mixed constraints or constraints and variables in a problem (Safitri, 2021). There are several terms used in solving problems using the two-phase method. According to Aini (2021), iteration refers to the number of processes or steps required to solve the problem. Non-base variables are variables whose values are set to zero at each iteration. Base variables are variables that have a non-zero value in each iteration. In the initial solution, if the constraint function in the problem is an ≤ inequality, then the base variable will contain a slack variable (S). However, if the constraint function is an inequality ≥ or =, then the base variable will be an artificial variable (R). Artificial variables are variables with very large values used to harmonise constraints, enabling their processing in linear programming. The solution or correct value is the value of the constraint resources that are still available. A slack variable is a variable added to the mathematical formulation to convert the inequality ≤ into an equation (=). All these terms are important elements in the two-phase method used to solve the optimal solution to linear programming problems.

According to Devani (2024), sensitivity analysis is a process to see how the optimal solution of a linear program changes when there is a change in the coefficients in the problem. Because this analysis is carried out after the optimal solution is found, it is often referred to as post-optimal analysis. The primary purpose of sensitivity analysis is to determine the extent to which changes in the objective function coefficients and the value of the right segment of the constraint can occur without changing the optimal solution that has been obtained (Ahmad, 2023). This analysis illustrates the extent to which changes in the objective function coefficients and the value in the right part of the constraint can occur without changing the results of the optimal solution.

The research to be carried out this time has two decision variables, namely Ayam Geprek (X_1) and Ayam Bakar (X_2), with the implementation of a solution using linear programming two-phase simplex method with a constraint function, namely order requests that require a total of 300 product orders, order processing time, and special product order requests. The optimisation problem to be revealed is about maximising profits (maximisation) based on the raw materials used and the time used while making chicken orders to get maximum profit.

Previous research serves as an important foundation in analysing and expanding the discussion in the research being conducted. By referring to previous studies, researchers can understand the approaches that have been used, the findings that have been achieved, and the gaps or limitations that still exist in previous research. In addition, the review of previous studies allows researchers to distinguish the current research from previous studies, both in terms of methodology, focus, and research objectives. In the context of this research, several journals and scientific articles related to the concept of linear programs are included to provide a more solid theoretical framework, as well as to show the relevance and contribution of this research to the development of science in the field.

Research conducted previously aligns with current research, but some studies, such as those by Tamiza (2023), Asmayanti (2021), Azizah (2023), and Nurmayati (2021), still use the simplex method to obtain profits. Meanwhile, research conducted by Safitri (2021) uses a two-phase method; however, each study lacks a sensitivity analysis of the results obtained.

2. Research Methods

The research took place from mid-May to the end of May 2023 at Kedai Ibu in Karawang Regency, West Java. Research instruments are tools used to collect data and information related to research (Hawin, 2019). This research instrument uses primary data. Primary data is data collected directly by researchers through various sources, including interviews, observations, and questionnaires. The research conducted utilises data obtained from interviews and field observations, thereby employing primary data.

The data in this study were obtained from interviews conducted directly with sellers of Ayam Geprek and Ayam Bakar during field studies. In field research, the author collects the data needed and related to the research through interviews and observations. Meanwhile, in literature research, the author gathers information related to the research theme through print and electronic media, such as articles, the internet, and other literature relevant to the research. The flow chart contained in the research is as follows.

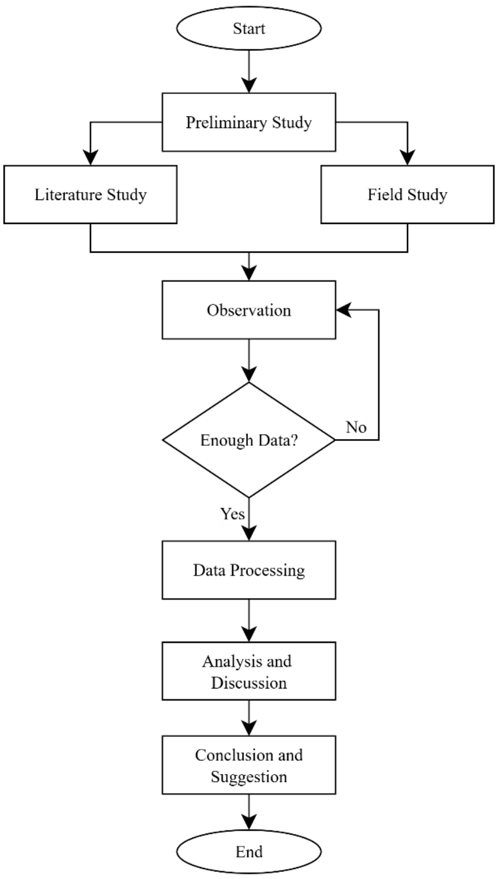

Figure 1. Flowchart

The research began with identifying problems within the company, followed by literature and field studies related to the research topic.

Data collection techniques are carried out in several ways, such as observation of processes related to research data or problems to be solved at the research site, interviews with business owners, and documentation in the form of production cost price data.

Data processing techniques using the Two-Phase Linear Program method to obtain optimal results, specifically the maximum profit obtained from the production carried out.

Analysis and Discussion: The results from data processing will inform proposals for Kedai Ibu food production, based on monthly orders. To ensure the final decision aligns with the objectives, in-depth analysis and discussion are necessary.

Conclusions and Suggestions: At this stage, the final research decision can be concluded, and some suggestions from the research activities that have been carried out can be recommended for factories or further research.

2.1 Linear Programming

According to Desyana (2024), optimisation is the process of finding the optimal solution to a problem using a mathematical model, and solving it can use methods such as linear programming, nonlinear programming, multiple objective programming, and others.

According to Budi Halomoan S. and Abil Mansyur (2020), linear programming is generally defined as a method for solving optimisation problems by modelling them as objective functions and constraints, both of which are linear. The linear program function is divided into two. First, the objective function is an analysis that determines the purpose of formulating the problem that occurs. A Constraint function that reviews existing resources and demand for the reviewed resources (Hartama, 2020).

The linear programming model contains three main aspects, namely: (1) Decision variables, are problem variables that will affect the value of the objectives to be obtained; (2) Objective function, is the goal to be obtained that must be realised into a linear mathematical formulation; (3) Functional constraints, are problems contained in the problem that will be put into mathematical formulations.

2.2 Two-Phase Method

The two-phase simplex method is a technique in linear programming that optimises problems involving multiple mixed constraints and variables. This method is carried out in two stages. The first stage involves optimising artificial variables to minimise the sum of all artificial variables, while the second stage optimises decision variables using the original linear programming objective function (Safitri, 2021).

There are several terms used in solving using the two-phase method as follows (Aini, 2021);

a. Iteration is the number of problem-solving processes or steps.
b. Non-base variables are variables whose values are set to zero at each iteration.
c. Base variables are variables that have a non-zero value in each iteration. In the initial solution, if the constraint function in the problem is an ≤ inequality, then the base

variable will contain a slack variable (S). However, if the constraint function is an inequality ≥ or =, then the base variable will be an artificial variable (R).

d. Artificial variables are variables with very large values used to harmonise constraints, enabling them to be processed in linear programming.
e. Solution or right value is the value of the constraint resources that are still available.
f. A slack variable is a variable added to the mathematical formulation to convert the inequality ≤ into an equation (=).

All of these terms are important elements in the two-phase method used to solve optimal solutions to linear programming problems.

The steps of the two-phase method are as follows:

Phase 1: Determining the feasible solution

In the first phase, the initial objective function is temporarily removed and replaced with the accumulation of the constraint function with the symbol r. The goal is to find a feasible solution by making artificial variables into non-base variables. In the first phase, the calculation process will stop after the calculation in the iteration has obtained a flexible solution characterised by the value of the objective function variable r being zero. The steps of the first phase are as follows:

a. Convert the linear programming model into standard form
b. Creating the initial simplex table
c. Determining the entering variable, namely the variable coefficient value in the objective function row that has the largest positive value.
d. Determine the leaving variable, which is the smallest positive value of the ratio value. The ratio value is obtained by dividing the right segment value by the value in the entering variable column.
e. Calculate the coefficient value on the new row variable by performing Gauss-Jordan elimination to get the new tableau result.
f. The solution is considered flexible if the objective function value (r) at the end of the first phase iteration is zero, and it continues in the second phase without including artificial variables (r).

The two-phase tableau on r minimisation is as follows.

Table 1. R Minimisation Tableau

Minimisation of R								
Base	x_1	x_2	x_n	S_1	S_2	S_n	R_1	Solution
r	$-c_1$	$-c_2$	$-c_n$	0	0	0	0	0
R_1	r_1	r_2	x_n	0	0	0	1	b_R
S_1	1_1	1_2	x_n	1	0	0	0	b_1
S_2	2_1	2_2	x_n	0	1	0	0	b_2
S_n	s_1	s_2	x_n	..	..	..	..	b_n

Phase 2: Determining the optimal solution

Phase 2 is a collection of iterations used to find the optimal value of the original objective function. The selection of entering variables in phase 2 in the maximisation case is by selecting the row coefficient of the objective function with the largest negative value. In phase 2, the artificial variable was replaced with the variable z.

Table 2. Z Maximisation Tableau

Maximisation of Z							
Base	x_1	x_2	x_n	S_1	S_2	S_n	Solution
Z	$-c_1$	$-c_2$	$-c_n$	0	0	0	0
S_1	1_1	1_2	x_n	1	0	0	b_1
S_2	2_1	2_2	x_n	0	1	0	b_2
S_n	s_1	s_2	x_n	..	..	..	b_n

Description:

1. The base is the column that has the same variable value as the right-hand side of the equation.
2. R is a penalty variable in the two-phase method to harmonise the constraints so that they can be processed in linear programming.
3. Z is the objective function of the problem.
4. $X_1 ... X_n$ is the value of the problem constraints.
5. $S_1 ... S_n$ is the slack variable used to convert the inequality into an equation.
6. The solution is the value resulting from the calculation of each row in the problem constraints.

2.3 Sensitivity Analysis

According to Devani (2024), sensitivity analysis is a process where the optimal solution to a linear program changes when there are changes in all coefficients of the problem. Because this sensitivity analysis is done after getting the optimal solution, it is often referred to as post-optimal analysis. The primary purpose of sensitivity analysis is to minimise or eliminate the need for recalculation when changes occur in one or more variables within the linear programming model, after the optimal solution has been achieved. Sensitivity analysis explains how far an optimum decision will be strong against changes in factors or parameters that affect the decision. Sensitivity analysis explains to what extent the coefficients of the objective function and the value of the right segment of the constraint can change without affecting the optimal solution. This means that by conducting a sensitivity analysis, the possible consequences of these changes can be predicted and anticipated in advance.

The calculation of the decision value limit used in this study is as follows.

$$([Cbv + x]\, x[B^{-1}]\, x[N] - [Cnbv]) \geq 0 \quad (1)$$

$$\left([Cbv1 \quad Cbv2 \quad Cbv3 + x]\, x \begin{bmatrix} b11 & b21 & b31 \\ b12 & b22 & b32 \\ b13 & b23 & bnn \end{bmatrix} x \begin{bmatrix} N1 \\ N2 \\ N3 \end{bmatrix} - [0] \right) \geq 0 \quad (2)$$

Description:

1. CBV is the cost coefficient of the base variable in the objective function. The addition of x is conditional on the variable to be sensitivity analysed. In this case, X2 as Cbv3 is the variable to be analysed.
2. Cnbv is the cost coefficient of the non-base variable in the objective function.
3. b11..bnn are the base coefficients in the problem constraints.
4. B-1 is the inverse matrix of the basis coefficients in the problem constraints.
5. N is the matrix of non-base coefficients in the problem constraints.

2.4 LINGO

LINGO software is a computer software used to solve optimisation problems. LINDO Systems, Inc. developed LINGO (Linear, Generalised, and Nonlinear Optimisation) and has become one of the most popular tools in the field of mathematical programming and optimisation. LINGO software can handle various types of optimisation problems, including linear programming, integer programming, nonlinear programming, and more. With LINGO, users can formulate a mathematical model for the problem they want to solve and utilise sophisticated optimisation algorithms to find the optimal or near-best solution.

3 Results and Discussion

3.1. Observation data

Observation data on production costs is used to determine the cost of producing one portion of Ayam Geprek and Ayam Bakar. Additionally, production costs are used to calculate the profit per portion of the sale of Ayam Geprek and Ayam Bakar.

Table 3. Cost per Portion

Ingredients	Unit	Price	Portion	Unit Price	
				Ayam Geprek	Ayam Bakar
Chicken	1 Kilogram	32000	8	IDR 4,000	IDR 4,000
Rice	1 Liter	10000	12	IDR 833	IDR 833
Oil	10 Liter	170000	150	IDR 1,133	IDR 1,133
Gas	1 Tube	22000	300	IDR 73	IDR 73
Flour	1 Kilogram	7500	40	IDR 188	IDR 0
Chili	1 Kilogram	30000	30	IDR 1,000	IDR 1,000
Garlic	1 Kilogram	30000	120	IDR 250	IDR 0
Vegetables	1 Kilogram	20000	30	IDR 667	IDR 667
Seasoning	1 Kilogram	13000	30	IDR 0	IDR 433
Packing	1 Package	28000	73	IDR 384	IDR 384
TOTAL				**IDR 8,144**	**IDR 8,140**

The profit cost observation data serves as the objective function coefficient for the observed problem, which is then solved using the two-phase method and analysed through sensitivity analysis.

Table 4. Profit per Portion

Calculate	Ayam Geprek	Ayam Bakar
Sell Price	IDR 12,000	IDR 12,000
Production Cost	IDR 8,144	IDR 8,140
Profit	IDR 3,856	IDR 3,860

The data above represents the observation data of the processing time per unit for the two observed units. It is known that it takes 0.75 minutes to produce one serving of Ayam Geprek, while the time required to produce one serving of Ayam Bakar takes 2.4 minutes. This processing time data will be required in the constraint function of the problem.

Table 5. Work Time

Menu	Time	Portion	Time / Unit
Ayam Geprek	60 minutes	80	0,75 menit
Ayam Bakar	60 minutes	25	2,4 menit

3.2 Problem Formulation

1. Decision Variable

Table 6. Decision Variable

Variable	Description
X_1	Ayam Geprek
X_2	Ayam Bakar

The decision variables in this case study are the number of orders of Ayam Geprek that must be produced and given the symbol $X1$ and the number of orders of Ayam Bakar that must be produced and given the symbol $X2$;

Objective Function

$$\text{Maximization } Z = 3.856X_1 + 3860X_2 \ldots\ldots\ldots(3)$$

The objective function in the study is to maximise the monthly booking revenue of chicken; therefore, profit is used as the objective function coefficient, calculated as the selling price minus the production cost of chicken per portion.

2. Constrain

Table 7: Constraint

Constrain	Ayam Geprek	Ayam Bakar	Maximum
Ayam	1	1	300
Time Work	0,75 menit	2,4 menit	480 menit
Request		1	50

The constraint functions in this case study are the required number of 300 chickens, the maximum capacity of processing time for 480 minutes, and special requests in the form of Ayam Bakar orders that cannot exceed 50 orders.

3. Mathematical Model Notation

The mathematical model of the problems contained in the study is as follows;

Table 8. Mathematical Model Notation

Constrain	Ayam Geprek	Ayam Bakar	Maximum
Chicken	1	1	300
Time Work	0.75 minutes	2.4 minutes	480 minutes
Request		1	50
Profit	IDR 3,856	IDR 3,860	

The mathematical form of the problem that occurs is as follows;

$$\begin{aligned}
\text{Max } Z &= 3856X_1 + 3860X_2 \\
X_1 + X_2 &= 300 \\
0{,}75X_1 + 2{,}4X_2 &<= 480 \\
X_2 &<= 50 \\
X_1, X_2 &>= 0
\end{aligned}$$

3.3 Two Phase

1. Transforming the Objective Function and Constraint Function into Canonical Form

The objective function is converted into a canonical form, which is all shifted to the left. Meanwhile, the constraint functions are transformed into equations by adding slack variables. Slack variables are labelled S_1, S_2,..., S_n according to the number of constraints. The addition of variable R, a penalty variable, ensures the optimal solution is worth zero in the first phase, allowing for the optimal solution value to be found in the second phase. Hence, the canonical form of the solution:

Max Z = $3856X_1 + 3860X_2$

r = R_1 = $300 - X_1 - X_2$

$X_1 + X_2 + R = 300$

$0,75 X_1 + 2,4 X_2 + s_1 = 480$

$X_2 + s_2 = 50$

2. Calculate the Problem Formulation

Phase one calculations using the two-phase method are as follows;

Table 9. Phase One Calculation

Minimisation of R								
Iteration	Base	X_1	X_2	S_1	S_2	R_1	Solution	Ratio
0	r	1	1	0	0	0	300	
	R_1	1	1	0	0	1	300	300
	S_1	0,75	2,4	1	0	0	480	640
	S_2	0	1	0	1	0	50	
1	r	0	0	0	0	-1	0	
	X_1	1	1	0	0	1	300	300
	S_1	0	1,65	1	0	-0,75	255	154,5455
	S_2	0	1	0	1	0	50	50

Since r is 0, the problem has a physical solution and can proceed to the next phase, phase 2.

Maximization Z

Max Z = 3856X1 + 3860X2

$X_1 + X_2 = 300$

$1,65X_2 + s_1 = 255$

$X_2 + s_2 = 50$

$Z = 3856(300 - X_2) + 3860X_2$

$Z - 4 X_2 = 1156800$

Table 10: Phase Two Calculation

Maximisation of Z								
Iteration	Base	z	X_1	X_2	S_1	S_2	Solution	Ratio
2	z	1	0	-4	0	0	1156800	
	X_1	0	1	1	0	0	300	300
	S_1	0	0	1,65	1	0	255	154,5455
	S_2	0	0	1	0	1	50	50
3	z	1	0	0	0	4	1157000	
	X_1	0	1	0	0	-1	250	
	S_1	0	0	0	1	-1,65	172,5	
	X_2	0	0	1	0	1	50	

After calculating up to three iterations, it is found that the first row, namely the row in the base variable Z, is positive. Then the solution can be said to be optimal up to the third iteration. With the following results;

Z = IDR 1,157,000

X_1 = 250 orders (Ayam Geprek)

X_2 = 50 orders (Ayam Bakar)

Furthermore, testing is conducted using Lingo software to verify the accuracy of manual calculations against software results.

3. Testing with LINGO

Testing using software aims to verify that manual calculations yield the same results as those obtained using software. The source code used to find the solution to the problem is attached in Figure 2.

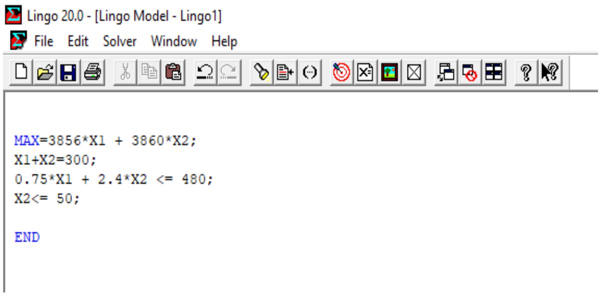

Figure 2. *Source Code*

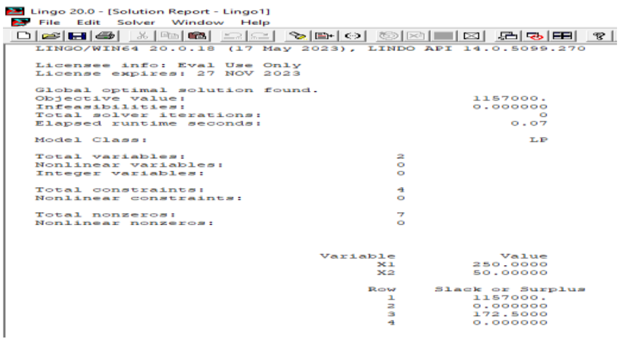

Figure 3. Result

3.4 Sensitivity Analysis

1. Sensitivity Analysis Calculation

For sensitivity analysis calculations, a limit value is needed, which becomes a benchmark for decisions that can be taken when the value of the variable changes. The calculations are as follows.

Calculating the optimum value limit

Limit Value $= Cbv\ x\ B^{-1}\ x\ N - Cnbv$

Limit Value =

$$\left(\begin{bmatrix} 3856 & 0 & 3860 + x \end{bmatrix} x \begin{bmatrix} 1 & 0 & -1 \\ -0{,}75 & 1 & -1{,}65 \\ 0 & 0 & 1 \end{bmatrix} x \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} - [0] \right) \geq 0$$

Limit Value $= (4 + x) \geq 0$

Limit Value $= X \geq -4$

This means that the optimal solution will not change as long as the coefficient value in the objective function variable X_2 is no more than -4. So, the limit for reducing profits so as not to change the number of portions is

Limit Value $= IDR\ 3{,}860 - IDR\ 4 = IDR\ 3{,}856$

2. Testing Value with LINGO

After conducting manual sensitivity analysis on the optimum solution, testing was performed using Lingo software to verify the consistency between manual and software calculations. The study tested the limits of how much the coefficient value at X_2 can change without altering the previously obtained optimum value. It can be seen in the "Allowable Decrease" column where the results show that the limit for adding the coefficient value to the variable Then it is known that in the "Allowable Decrease" column the reduction limit on the coefficient of the variable X_2 is four or in this case IDR 4, meaning that if the value reduction is more than 4, then the old optimum solution will change the results of the X_2 coefficient value, namely Ayam Bakar.

Based on the results of the two-phase calculations in the previous section, it can be concluded that the mother shop has the opportunity to obtain optimal profits from the orders submitted. These benefits can be achieved by paying attention to the predetermined order request limits and processing times. Currently, Ibu's shop has the capacity to produce 250 orders of fried chicken and 50 orders of Ayam Bakar, which produces a total profit of IDR 1,157,000.

After carrying out a sensitivity analysis on the second variable, namely Ayam Bakar, we provide suggestions for shop owners. Suppose the owner wants to change the profit price on one test variable, but still obtains optimum profit from reducing the profit price. In that case, the owner can reduce the profit by no more than IDR. 4 on the variable coefficient X_2, which is the variable for Ayam Bakar. Value IDR 4 is the optimum limit for reducing the coefficient of the variable X_2 in the objective function of ordering Ayam Bakar. Owners should note that adding the coefficient X_2 value will not alter the optimum results of the previous solution.

Reducing the coefficient X_2 by more than IDR 4 will impact the new optimal solution. The portion of Ayam Bakar orders will be worth 0, while fried chicken orders will increase to 300 orders. The profit that will be obtained on the next order is IDR 1,156,800.

Shop owners can optimise profits by considering the profit price limit on the Ayam

Bakar variable (X_2), which is no more than IDR 4. Even though the addition of the X_2 coefficient value does not have an impact on the optimum results, the reduction exceeding IDR 4 will result in a new optimal solution. Owners need to be wise in managing profit strategies to ensure continuity and balance in the Kedai Ibu business.

Therefore, it is important for shop owners to monitor demand continuously and order processing times, as well as adapt to changes in the market and customer preferences. In this way, your shop can continue to run well and achieve optimal profits in the long term.

4 Conclusion

Optimising profits for a business can be calculated using linear programming. The linear programming method consists of many derivative methods that can be used depending on the problem at hand. In the case of ordering chicken at UMKM Kedai Ibu, a two-phase method is used because there are variables that have different inequality signs from other variables. Furthermore, to determine the limit value that can serve as a reference for business owners to maximise their profits, this research employs a sensitivity analysis method based on the optimal results from the previous two-phase method.

Based on the results of the analysis carried out previously using the two-phase method, the results show that Kedai Ibu can optimise profits from orders submitted by the customer based on production costs and manufacturing time per unit, as well as the limits set by the customer, by producing 250 portions of Ayam Geprek and Ayam Bakar, and 50 portions. In this way, Kedai Ibu will get a profit of IDR 1,157,000 from the total production order of 300 portions of chicken. Overall, it can be concluded that to maximise profits in optimising production results, implementing the simplex method of linear programming is necessary. This approach ensures that the calculation results show the optimum amount of production to achieve maximum profits. Furthermore, if the owner aims to maximise income by reducing the price of Ayam Bakar, the minimum reduction limit, as determined by the previous analysis, should not exceed IDR 4 if it exceeds that number. So, the owner can produce monthly orders in the following month of 300 portions of fried chicken and zero portions of Ayam Bakar.

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