Jurnal Sains Matematika dan Statistika
p-ISSN: 2460-4542
e-ISSN: 2615-8663

Application of the Two-Phase Simplex Method and *the Two-Phase Quick* Simplex Method in Minimizing Raw Material Costs People with *Diabetes Mellitus*

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Submitted : 16 Mei 2025 Accepted : 20 Januari 2026 Published : 21 Januari 2026

Abstract

Diabetes Mellitus (DM) is a long-term metabolic disease or disorder caused by various factors and is characterized by an increase in high blood sugar levels, accompanied by dysfunction in the metabolism of carbohydrates, fats, and proteins as a result of impaired insulin function. Ibnu Sina Hospital Pekanbaru provides treatment to patients suffering from *Diabetes Mellitus* by applying a type IV diet with normal nutritional status and BMI in the interval of 18 to 25 BMI. In the process of making food, Ibnu Sina Hospital uses raw materials such as rice, fish, tempeh, broccoli and bananas. The purpose of the study is to find out the minimum cost that must be incurred for food raw materials at Ibnu Sina Hospital Pekanbaru for patients with *Diabetes Mellitus*. The methods used are the two-phase simplex method and *the* two-phase quick simplex method. Based on the results of this study, the two-phase simplex method requires 5 iterations, while *the* two-phase quick simplex method only requires 1 iteration to obtain optimal results. So that the *quick* simplex method is more efficient than the two-phase simplex method because it is seen from the number of iterations carried out. In both methods, it was obtained that the minimum production cost of food raw materials for *patients with diabetes mellitus* was Rp. 9,138.5.
Keywords: *Diabetes Mellitus*, BMI, Two-Phase Simplex Method, Two-Phase Quick Simplex Method, Ibnu Sina Hospital.

Abstract

Diabetes Mellitus (DM) is a chronic condition or disorder of metabolism caused by various factors and characterized by elevated blood sugar levels, accompanied by dysfunction in the metabolism of carbohydrates, fats, and proteins as a consequence of insulin function impairment. Ibn Sina Hospital in Pekanbaru provides care for patients suffering from diabetes mellitus by implementing a type IV diet with normal nutritional status and IMT ranging from 18 to 25. In the food production process, Ibn Sina Hospital uses raw materials such as rice, fish, tempeh, broccoli, and bananas. The aim of the research is to find out the minimum costs that mush be incurred for food raw materials at Ibnu Sina Pekanbaru Hospital for patients suffering from diabetes mellitus. The applied methods involve The Two-Phase Simplex Method and The Quick Two-Phase Simplex Method. According to the findings of this research, The Two-Phase Simplex Method requires 5 iterations, while The Quick Two-Phase Simplex Method only requires 1 iteration to obtain optimal result. So The Quick Simplex Method is more efficient than The Two-Phase Simplex Method because it is seen from the number of iterations carried out. In both methods, it is determined that the minimum production cost of food raw materials for diabetes mellitus patients is Rp. 9,138.5.

***Keywords*:** Diabetes mellitus, Ibnu Sina Pekanbaru Hospital, IMT, Two-Phase Quick Simplex Method Two-Phase Simplex Method.

1. Introduction

In line with current developments, costs are an aspect that is always related to daily life. One of them is the cost of producing an item. Production cost considerations need to be carefully calculated to minimize the amount of costs. Success in achieving maximum profit depends on accurate production quantity planning [1].

One application for determining the optimal combination of frequently used limited resources is linear programming. Solutions for linear programs can be determined manually or with the help of *Software* [2] . The method that is often used to complete a linear program is the simplex method. According to , the simplex method is an iterative algebraic procedure to achieve the most favorable or optimal value of the objective function. For the minimum case because the inequality is marked "≥" and "=", the method used is the Two-Phase Simplex Method [3].

The Two-Phase Simplex Method is one of the methods in a linear program to get optimal results involving mixed constraints in a problem. One of the advantages of the two-phase simplex method is that it provides answers to problems that may or may not have a viable solution [4]. In addition to the Two-Phase Simplex method, there is also the *quick* simplex method that involves the completion of a linear program by converting the formulation of a linear program into a matrix that aims to reduce the number of iterations carried out to obtain an optimal solution. The *Quick* Simplex method has the ability to replace several basic variables simultaneously to get the optimal solution [5].

Previous research related to the Two-Phase Simplex Method and Method *Quick* Two-Phase Simplex i.e. research [6] in resolving the case of the Pekanbaru Mitra Clothing Shop, the results were obtained that Two-Phase Simplex Method and Method *Quick* Two-Phase Simplex which uses for the maximum case obtains the same value result. Judging from the iterations carried out, Two-Phase Simplex Method requires four iterations whereas Method *Quick* Two-Phase Simplex It only takes one iteration to achieve optimal results.

Furthermore, in the study with the results of the study showed that for the [7] *Quick* Two-Phase Simplex Selection Incoming variables and Exit variable can be muffled with two elements at once, resulting in a smaller number of iterations compared to the Two-Phase Simplex Method. Other research was also conducted by with the results of the study showing that the [8] *Quick* Simplex is more efficient as compared to the Dual Simplex Method. This can be seen from the shorter processing time and the number of iterations required in the Method *Quick* Simplex. For the Dual Simplex Method, two iterations are carried out while the Method *Quick* Simplex one iteration with the same optimal result value.

Furthermore, the research with the results of the research that the number of iterations obtained by the Method [9] *Quick* There are fewer simplexes as compared to the Two-Phase Simplex Method. Other research was also conducted by [10] Discuss the application of the method *Quick* two-phase simplex and two-phase simplex method completion which results in that iteration of the *Quick* There are fewer simplexes compared to the two-phase simplex method. Based on the research [6] with the maximum case, the author is interested in reviewing the research with the minimum case with the title "**Application of the Two-Phase Simplex Method and Method *Quick* Two-Phase Simplex in Minimizing the Cost of Raw Materials for Patients with Diseases *Diabetes Mellitus***". The objectives of this study are to find out the minimum cost that must be incurred for food raw materials at Ibnu Sina Hospital Pekanbaru for patients with *Diabetes Mellitus*.

2. Research Methods

2.1 Linear Program

One of the mathematical models in solving the problem of optimizing linear programs with the function of maximizing profits or minimizing costs. This process involves identifying the cause of the problem and setting goals [11] . According to [12] , Linear programming is a mathematical method that has linear characteristics, which focuses on maximizing or minimizing objective functions under certain constraints in order to achieve optimal solutions.

The general formulation of linear programs is [13].

$$Maks\ atau\ min\ z = c_1x_1 + c_2x_2 + \cdots + c_nx_n \quad (1)$$

Constraints

$$a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n =/\leq/\geq b_1$$
$$a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n =/\leq/\geq b_2$$
$$\vdots \quad \vdots \quad \vdots \quad \vdots$$
$$a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n =/\leq/\geq b_m$$
$$x_1, x_2, \dots, x_n \geq 0$$

Description:

x_j : Variable results to - $j; j = 1, 2, \dots, n;$

c_j : The coefficient of the objective function to- j; $j = 1, 2, \ldots, n$;

a_{ij}: Coefficient of constraint function, $i = 1, 2, \ldots m$ dan $j = 1, 2, \ldots, n$;

b_i : Capacity constraint function, $i = 1, 2, \ldots m$.

2.2 Method Two-Phase Simplex

The Two-Phase Simplex Method is one of the methods in a linear program to get optimal results involving mixed constraints in a problem. Two phases are the optimization process carried out in two separate phases. Phase 1 aims to optimize artificial variables (r) and phase 2 is carried out to optimize decision variables. In the first stage, an attempt is made to achieve a zero value for the artificial variable because in fact the artificial variable has no significance in the context of the problem at hand [14].

The procedure for completing the Two-Phase Simplex Method is:

Phase 1: Identify eligible solutions.

The purpose of phase 1 is to determine whether the problem being faced has a viable solution. In the early stages of phase 1, the objective function is modified by reducing the number of artificial variables by minimizing them.

1. Converting the linear program model into a default form adds *a slack* variable for the one marked "≤" and subtracts the *surplus* variable and adds *an artificial* variable for the one marked "≥" and adds *an artificial* variable for the one marked "=".
2. Compile a simple method initial table.
3. Determine the incoming variable by selecting the variable on the line of the destination function that has the largest positive coefficient, especially in the case of minimization.
4. Determine the output variable by selecting the variable in the ratio column that has the smallest positive ratio value.
5. Perform Gauss-Jordan elimination to generate *a new* z.
6. The solution is said to be optimal if the objective function is equal to 0, then proceed to phase 2. However, if the value is positive or $R \geq 0$ or there is a repetition of retrieval of the incoming and outgoing variables, the process is terminated because the solution is considered unqualified (unfiscible).

Phase 2: Identify the optimal solution.

Using an optimal base solution from phase 1 results used as an initial solution without involving artificial variables. Settlement is continued using the usual simplex method. If the coefficients on the row of the destination function have all negative values, then the solution is optimal and there is no need for further iteration.

2.3 Method *Quick* Two-Phase Simplex

Method *Quick* Simplex is a solution to a linear program problem by performing fewer iterations in two phases. Method completion procedure *Quick* Two-phase simplex:

Phase 1: Identify eligible solutions.

DOI : https://dx.doi.org/10.24014/jsms.v12i1.37040

This phase is carried out to determine whether the problem being solved has adequate results.

The objective function at the beginning of phase one is modified by reducing the number of artificial variables by minimizing. Here are the steps to solve it:

1. Converts the model into a standard form.
2. Compile a simple method initial table.
3. Determine the incoming variable by selecting a value $z_j - c_j$ with a positive value. Define a value $z_j - c_j$ using the formula:

$$z_j - c_j = \sum_{j=1}^{n} C_B P_j - c_j$$

4. Determine the leaving *variable* by selecting the smallest positive ratio.
5. Assign an R-value. Where R is the determinant of matrix A. To make matrix A can be seen in Table 1 below:

Table 1. Matrix A Quick Simplex Method

x_1	x_2	x_3	$Nilai\ Kanan$	s_5	s_6	s_7	s_8
$pivot\ x_{11}$	x_{12}	x_{13}	b_1	1	0	0	0
x_{21}	$pivot\ x_{22}$	x_{23}	b_2	0	1	0	0
x_{31}	x_{32}	$pivot\ x_{33}$	b_3	0	0	1	0
x_{41}	x_{42}	x_{43}	b_4	0	0	0	1

Based on Table 1, matrix A can be arranged as follows:

$$A = \begin{vmatrix} x_{11} & x_{12} & x_{13} & b_1 \\ x_{21} & x_{22} & x_{23} & b_2 \\ x_{31} & x_{32} & x_{33} & b_3 \\ x_{41} & x_{42} & x_{43} & b_4 \end{vmatrix} \quad (2)$$

Formula R with two variables:

$$R = det \begin{vmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{vmatrix}$$

Formula R with three variables:

$$R = det \begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{vmatrix} \quad (3)$$

6. Use the *quick* simplex method to get a new element, where R is the denominator. The *quick* simplex method has two forms of formulas that can be used, namely:
   a. If there are two variables, then find the element values for the updated simplex table using the formula that can be seen in Table 2 below:

Table 2. Value $x_1^{**}, x_2^{**}, s_3^{**}, s_4^{**}$

$x_1^{**} = \frac{(-1)^1 \begin{vmatrix} x_{12} & x_{13} \\ x_{22} & x_{23} \end{vmatrix}}{R}$	$x_2^{**} = \frac{(-1)^2 \begin{vmatrix} x_{11} & x_{13} \\ x_{21} & x_{23} \end{vmatrix}}{R}$
$s_3^{**} = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{vmatrix}}{R}$	$s_4^{**} = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{41} & x_{42} & x_{43} \end{vmatrix}}{R}$

b. If there are more than two variables or $n > 2$ using the formula which can be seen in Table 3 below:

Table 3. for the variable$n > 2$

x_1	x_2	x_3	NK	s_5	s_6	s_7	s_8
1	0	0	$x_1^{***} = \frac{\begin{vmatrix} x_{12} & x_{13} & b_1 \\ x_{22} & x_{23} & b_2 \\ x_{32} & x_{33} & b_3 \end{vmatrix}}{\begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{vmatrix}}$				0
0	1	0	$x_2^{***} = \frac{\begin{vmatrix} x_{11} & b_1 & x_{13} \\ x_{21} & b_2 & x_{23} \\ x_{31} & b_3 & x_{33} \end{vmatrix}}{\begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{vmatrix}}$				0
0	0	1	$x_3^{***} = \frac{\begin{vmatrix} x_{11} & x_{12} & b_1 \\ x_{21} & x_{22} & b_2 \\ x_{31} & x_{32} & b_3 \end{vmatrix}}{\begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{vmatrix}}$				0
0	0	0	$s_4^{***} = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{11} & b_1 \\ x_{21} & x_{22} & x_{23} & b_2 \\ x_{31} & x_{32} & x_{33} & b_3 \\ x_{41} & x_{42} & x_{43} & b_4 \end{vmatrix}}{\begin{vmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{vmatrix}}$				1

7. The solution is said to meet the feasible if the value on the line $z_j - c_j \leq 0$. If there are still positive values, continue the iteration using the Gauss-Jordan elimination method. If all values are negative or zero, then the process is continued to Phase 2.

Phase 2: Identifying the optimal solution

The optimal solution found in Phase 1 is used as an initial solution for initial completion. If all the elements on $z_j - c_j \leq 0$ or none of them have a positive value, then the solution is optimal.

3. Results and Discussion

The data used in this study is data obtained from the Final Project. The data taken included data on nutritional content, food raw material prices and dietary standards for [15] *type IV diabetes mellitus* at Ibnu Sina Hospital Pekanbaru.

a. Completion using the Two-Phase Simplex Method

This study uses the type of raw material as a decision variable. Here are the decision variables:

x_1 : The amount of rice consumed (gr) per meal;
x_2 : The amount of fish consumed (gr) per meal;
x_3 : The amount of tempeh consumed (gr) per meal;
x_4 : The amount of broccoli consumed (gr) per meal;

x_5 : The amount of bananas consumed (gr) per meal.

Here's the form of a linear program model:

Minimum $z = 1.605x_1 + 3.150x_2 + 225x_3 + 750x_4 + 1.800x_5$ (4)

Constraints: $246x_1 + 187x_2 + 232x_3 + 34x_4 + 180x_5 = 1.700$

$3x_1 + 28x_2 + 14x_3 + 3x_4 + 2x_5 = 55$

$0{,}3x_1 + 8x_2 + 12x_3 + 0{,}6x_4 + 0{,}3x_5 = 35$

$60x_1 + 14x_3 + 12x_4 + 23x_5 = 275$

$0{,}2x_2 + 0{,}2x_3 + 6x_4 + 6x_5 = 16$

$x_1, x_2, x_3, x_4, x_5 \geq 0$

1. Converts a linear program model into a standard form.

Because the inequality marked "≥" is changed to the form " = " by adding the aritifical variable, namely and . Based on Equation (4), the standard form of the linear program model is obtained as follows:$R_1, R_2, R_3, R_4 R_5$

Min $z = 1.605x_1 + 3.150x_2 + 225x_3 + 750x_4 + 1.800x_5 + MR_1 + MR_2 + MR_3 + MR_4 + MR_5$

Constraints$246x_1 + 187x_2 + 232x_3 + 34x_4 + 180x_5 + R_1 = 1.700;$

$3x_1 + 28x_2 + 14x_3 + 3x_4 + 2x_5 + R_2 = 55;$ (5)

$0{,}3x_1 + 8x_2 + 12x_3 + 0{,}6x_4 + 0{,}3x_5 + R_3 = 35;$

$60x_1 + 14x_3 + 12x_4 + 23x_5 + R_4 = 275;$

$0{,}2x_2 + 0{,}2x_3 + 6x_4 + 6x_5 + R_5 = 16;$

$R_1, R_2, R_3, R_4,\ R_5 \geq 0.$

Phase 1: Identifying feasible solutions

In Phase 1, the objective function in Equation (5) is replaced by the value R_1, R_2, R_3, R_4 and R_5 because it serves as the initial base variable. Based on the constraints in Equation (5) it is obtained:

$$R_1 = 1.700 - 246x_1 - 187x_2 - 232x_3 - 34x_4 - 180x_5; \quad (6)$$

$$R_2 = 55 - 3x_1 - 28x_2 - 14x_3 - 3x_4 - 2x_5; \quad (7)$$

$$R_3 = 35 - 0{,}3x_1 - 8x_2 - 12x_3 - 0{,}6x_4 - 0{,}3x_5; \quad (8)$$

$$R_4 = 275 - 60x_1 - 14x_3 - 12x_4 - 23x_5; \quad (9)$$

$$R_5 = 16 - 0{,}2x_2 - 0{,}2x_3 - 6x_4 - 6x_5. \quad (10)$$

Based on Equations (6), (7), (8), (9) and (10), a new purpose function is obtained, namely:

$\min r = R_1 + R_2 + R_3 + R_4 + R_5$

$\min r = (1.700 - 246x_1 - 187x_2 - 232x_3 - 34x_4 - 180x_5) + (55 - 3x_1 - 28x_2 - 14x_3 - 3x_4 - 2x_5) + (35 - 0{,}3x_1 - 8x_2 - 12x_3 - 0{,}6x_4 - 0{,}3x_5) + (275 - 60x_1 - 14x_3 - 12x_4 - 23x_5) + (16 - 0{,}2x_2 - 0{,}2x_3 - 6x_4 - 6x_5)$

$r = 2.081 - 309{,}3x_1 - 223{,}2x_2 - 272{,}2x_3 - 55{,}6x_4 - 211{,}3x_5$

$r + 309{,}3x_1 + 223{,}2x_2 + 272{,}2x_3 + 55{,}6x_4 + 211{,}3x_5 = 2.081;$ (11)

Constraints $246x_1 + 187x_2 + 232x_3 + 34x_4 + 180x_5 + R_1 = 1.700;$

$3x_1 + 28x_2 + 14x_3 + 3x_4 + 2x_5 + R_2 = 55;$

$0{,}3x_1 + 8x_2 + 12x_3 + 0{,}6x_4 + 0{,}3x_5 + R_3 = 35;$

$60x_1 + 14x_3 + 12x_4 + 23x_5 + R_4 = 275;$

$0{,}2x_2 + 0{,}2x_3 + 6x_4 + 6x_5 + R_5 = 16;$

$x_1, x_2, x_3, x_4, x_5, R_1, R_2, R_3, R_4, R_5 \geq 0.$

		0	0	0	0	0	1	1	1	1	1		
CB	**VB**	x_1	x_2	x_3	x_4	x_5	R_1	R_2	R_3	R_4	R_5	**NK**	**Ratio**
0	r	309,3	223,2	272,2	55,6	211,3	0	0	0	0	0	2.081	
1	R_1	246	187	232	34	180	1	0	0	0	0	1.700	6,91
1	R_2	3	28	14	3	2	0	1	0	0	0	55	18,33
1	R_3	0,3	8	12	0,6	0,3	0	0	1	0	0	35	10,6
1	R_4	60	0	14	12	23	0	0	0	1	0	275	4,583
1	R_5	0	0,2	0,2	6	6	0	0	0	0	1	16	-
	$z_j - c_j$	309,3	223,2	272,2	55,6	211,3	0	0	0	0	0		

2. Compile a model into a simplex start table

The entries in Equation (11) are included in the following Table 4:

		0	0	0	0	0	1	1	1	1	1		
CB	**VB**	x_1	x_2	x_3	x_4	x_5	R_1	R_2	R_3	R_4	R_5	**NK**	**Ratio**
0	r	0	223,2	200,03	-6,26	92,735	0	0	0	-5,155	0	663,4781	
1	R_1	0	187	174,6	-15,2	85,7	1	0	0	-4,1	0	572,5	3,06
1	R_2	0	28	13,3	2,4	0,85	0	1	0	-0,05	0	41,25	1,47
1	R_3	0	8	11,93	0,54	0,185	0	0	1	-0,005	0	33,625	4,2
0	x_1	1	0	0,2333	0,2	0,3833	0	0	0	0,0167	0	4,583	-
1	R_5	0	0,2	0,2	6	6	0	0	0	0	1	16	80
	$z_j - c_j$	0	223,2	200,03	-6,26	92,735	0	0	0	-5,155	0		

Table 4. Beginning of Simplex Phase 1

Incoming variables Exit variables

3. Selecting the input variable on the r-line is the largest positive element that is $x_1 = 309{,}3$
4. Selects the variable out of the ratio with the smallest positive value that is $R_4 = 4{,}582$.
5. Calculate new rows using the Gauss-Jordan elimination which can be seen in Table 5.
6. Calculate the value of the objective function

Table 5. Iteration 1 of the Phase 1 Simplex Method

Incoming variables Exit variables

Because the r line is still positive, the iteration continues. After 5 iterations, the optimal solution was obtained which can be seen in Table 6 below:

Table 6. Iteration 5 of the Simplex Method Phase 1

		1.605	3.150	225	750	1.800	
CB	VB	x_1	x_2	x_3	x_4	x_5	NK
0	z	0	0	0	0	0	9.138,5
1.800	x_5	0	0	0	0	1	1,2966
3.150	x_2	0	1	0	0	0	0,033
225	x_3	0	0	1	0	0	2,7184
1.605	x_1	1	0	0	0	0	3,1963
750	x_4	0	0	0	1	0	1,2783
	$z_j - c_j$	0	0	0	0	0	

Based on Table 6, because the r *line* is already negative or zero, the optimal solution is obtained and proceeded to Phase 2 without including artificial variables.

Phase 2: Determining the optimal solution

Based on Table 6, the initial solution of Phase 2 is obtained which can be seen in Table 7 below:

Table 7. Simplex Method Phase 2

Based on Table 7, because the z line is already zero, the solution is optimal. So that optimal solution results are obtained, $x_1 = 3,1963; x_2 = 0,033; x_3 = 2,7184; x_4 = 1,2783; x_5 = 1,2966$ namely and $z = 9.138,5$.

b. Completion using the Two-Phase Quick Simplex Method

Phase 1: Identifying feasible solutions

1. Convert a model into a standard form

   The standard form of the linear program model can be seen in Equation (5).

2. Forming a simplex initial table

   Based on Equation (5), the entries are entered into Table 8 to determine the value of R which can be seen in the following Table 8:

		0	0	0	0	0	1	1	1	1	1	
CB	**VB**	x_1	x_2	x_3	x_4	x_5	R_1	R_2	R_3	R_4	R_5	**NK**
0	r	0	0	0	0	0	-1	-1	-1	-1	-1	0
0	x_5	0	0	0	0	1	0,0091	-0,0334	-0,0962	-0,035	0,0449	1,2966
0	x_2	0	1	0	0	0	0,0005	0,0504	-0,0641	-0,0045	-0,013	0,033
0	x_3	0	0	1	0	0	-0,0001	-0,0348	0,124	0,0015	0,0025	2,7184
0	x_1	1	0	0	0	0	-0,0016	0,0143	-0,0109	0,0227	-0,0422	3,1963
0	x_4	0	0	0	1	0	-0,0091	0,0328	0,0942	0,0351	0,1221	1,2783
	$z_j - c_j$	0	0	0	0	0	-1	-1	-1	-1	-1	

Table 8. Phase 1 Initial Solutions

CB	VB	0	0	0	0	0	1	1	1	1	1						
		x_1	x_2	x_3	x_4	x_5	R_1	R_2	R_3	R_4	R_5	NK	RS1	RS2	RS3	RS4	RS5
1	R_1	246	187	232	34	180	1	0	0	0	0	1.700	6,91	9,09	7,32	50	9,44
1	R_2	3	28	14	3	3	0	1	0	0	0	55	18,33	1,96	3,92	18,33	18,33
1	R_3	0,3	8	12	0,6	0,6	0	0	1	0	0	35	116,6	4,37	2,91	58,33	58,33
1	R_4	60	0	14	12	12	0	0	0	1	0	275	4,58	-	19,64	22,91	22,91
1	R_5	0	0,2	0,2	6	6	0	0	0	0	1	16	-	80	80	2,66	2,66
	$z_j - c_j$	309,3	225	272,2	55,6	201,6	0	0	0	0	0						

Where $RS_1, RS_2, RS_3, RS_4, RS_5$: Ratio.

3. Selecting a variable in simultaneously

   Based on Table 8, select the entry variable on the row $z_j - c_j$ with a positive value, i.e. .x_1, x_2, x_3, x_4, x_5

4. Selecting Outgoing Variables Simultaneously

   Based on Table 8, select the variable out of the ratio with the smallest positive value, namely R_1, R_2, R_3, R_4, R_5.

5. Determining the Element of the Star

   R is the determinant of matrix A. The value of R is obtained from the elements contained in Table 5. So that the R value is obtained which can be seen in Table 9 below:

CB	VB	0	0	0	0	0	1	1	1	1	1						
		x_1	x_2	x_3	x_4	x_5	R_1	R_2	R_3	R_4	R_5	NK	RS_1	RS_2	RS_3	RS_4	RS_5
1	R_1	$x_{11} = 246$	$x_{12} = 187$	$x_{13} = 232$	$x_{14} = 34$	$x_{15} = 180$	1	0	0	0	0	1.700	6,91	9,09	7,32	50	9,44
1	R_2	$x_{21} = 3$	$x_{22} = 28$	$x_{23} = 14$	$x_{24} = 3$	$x_{25} = 2$	0	1	0	0	0	55	18,33	1,96	3,92	18,33	18,33
1	R_3	$x_{31} = 0.3$	$x_{32} = 8$	$x_{33} = 12$	$x_{34} = 0,6$	$x_{35} = 0,3$	0	0	1	0	0	35	116,6	4,37	2,91	58,33	58,33
1	R_4	$x_{41} = 60$	$x_{42} = 0$	$x_{43} = 14$	$x_{44} = 12$	$x_{45} = 23$	0	0	0	1	0	275	4,58	-	19,64	22,91	22,91
1	R_5	$x_{51} = 0$	$x_{52} = 0,2$	$x_{53} = 0,2$	$x_{54} = 6$	$x_{55} = 6$	0	0	0	0	1	16	-	80	80	2,66	2,66
	$z_j - c_j$	309,3	225	272,2	55,6	201,6	0	0	0	0	0						

Table 9. R Value of *the* Two-Phase Quick Simplex Method

Where $RS_1, RS_2, RS_3, RS_4, RS_5$: Ratio.

Based on Table 9, matrix A is obtained as follows:

$$A = \begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & x_{15} & b_1 \\ x_{21} & x_{22} & x_{23} & x_{24} & x_{25} & b_2 \\ x_{31} & x_{32} & x_{33} & x_{34} & x_{35} & b_3 \\ x_{41} & x_{42} & x_{43} & x_{44} & x_{45} & b_4 \\ x_{51} & x_{52} & x_{53} & x_{54} & x_{55} & b_5 \end{vmatrix} = \begin{vmatrix} 246 & 187 & 232 & 34 & 180 & 1.700 \\ 3 & 28 & 14 & 3 & 2 & 55 \\ 0,3 & 8 & 12 & 0,6 & 0,3 & 35 \\ 60 & 0 & 14 & 12 & 23 & 275 \\ 0 & 0,2 & 0,2 & 6 & 6 & 16 \end{vmatrix}$$

because there are five input and output variables, the R value is obtained, namely:

$$R = det \begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & x_{15} \\ x_{21} & x_{22} & x_{23} & x_{24} & x_{25} \\ x_{31} & x_{32} & x_{33} & x_{34} & x_{35} \\ x_{41} & x_{42} & x_{43} & x_{44} & x_{45} \\ x_{51} & x_{52} & x_{53} & x_{54} & x_{55} \end{vmatrix} = det \begin{vmatrix} 246 & 187 & 232 & 34 & 180 \\ 3 & 28 & 14 & 3 & 2 \\ 0,3 & 8 & 12 & 0,6 & 0,3 \\ 60 & 0 & 14 & 12 & 23 \\ 0 & 0,2 & 0,2 & 6 & 6 \end{vmatrix} = 9.022.199,58$$

6. Generates an element value for an updated simplex table.

Because there are five incoming and outgoing variables selected simultaneously, a new simplex table can be found which can be seen in the following Table 10:

Table 10. New Value of *Two-Phase* Quick Sample Method

CBVB **0 0 0 0 0** $x_1 x_2 x_3 x_4 x_5$	**1** R_1	**1** R_2	**1** R_3	**1** R_4	**1** R_5	**NK**
	$=\frac{\begin{vmatrix}1&x_{12}&x_{13}&x_{14}&x_{15}\\0&x_{22}&x_{23}&x_{24}&x_{25}\\0&x_{32}&x_{33}&x_{34}&x_{35}\\0&x_{42}&x_{43}&x_{44}&x_{45}\\0&x_{52}&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}0&x_{12}&x_{13}&x_{14}&x_{15}\\1&x_{22}&x_{23}&x_{24}&x_{25}\\0&x_{32}&x_{33}&x_{34}&x_{35}\\0&x_{42}&x_{43}&x_{44}&x_{45}\\0&x_{52}&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}0&x_{12}&x_{13}&x_{14}&x_{15}\\0&x_{22}&x_{23}&x_{24}&x_{25}\\1&x_{32}&x_{33}&x_{34}&x_{35}\\0&x_{42}&x_{43}&x_{44}&x_{45}\\0&x_{52}&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}0&x_{12}&x_{13}&x_{14}&x_{15}\\0&x_{22}&x_{23}&x_{24}&x_{25}\\0&x_{32}&x_{33}&x_{34}&x_{35}\\1&x_{42}&x_{43}&x_{44}&x_{45}\\0&x_{52}&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}0&x_{12}&x_{13}&x_{14}&x_{15}\\0&x_{22}&x_{23}&x_{24}&x_{25}\\0&x_{32}&x_{33}&x_{34}&x_{35}\\0&x_{42}&x_{43}&x_{44}&x_{45}\\1&x_{52}&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}b_1&x_{12}&x_{13}&x_{14}&x_{15}\\b_2&x_{22}&x_{23}&x_{24}&x_{25}\\b_3&x_{32}&x_{33}&x_{34}&x_{35}\\b_4&x_{42}&x_{43}&x_{44}&x_{45}\\b_5&x_{52}&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$
0 x_1 **1 0 0 0 0**	$=\frac{\begin{vmatrix}1&187&232&34&180\\0&28&14&3&2\\0&8&12&0,6&0,3\\0&0&14&12&23\\0&0,2&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}0&187&232&34&180\\1&28&14&3&2\\0&8&12&0,6&0,3\\0&0&14&12&23\\0&0,2&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}0&187&232&34&180\\0&28&14&3&2\\1&8&12&0,6&0,3\\0&0&14&12&23\\0&0,2&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}0&187&232&34&180\\0&28&14&3&2\\0&8&12&0,6&0,3\\1&0&14&12&23\\0&0,2&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}0&187&232&34&180\\0&28&14&3&2\\0&8&12&0,6&0,3\\0&0&14&12&23\\1&0,2&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}1.700&187&232&34&180\\55&28&14&3&2\\35&8&12&0,6&0,3\\275&0&14&12&23\\16&0,2&0,2&6&6\end{vmatrix}}{9.022.199,58}$
	$= -0,0016$	$= 0,0143$	$= -0,0109$	$= 0,0227$	$= -0,0422$	$= 3,1963$
	$=\frac{\begin{vmatrix}x_{11}&1&x_{13}&x_{14}&x_{15}\\x_{21}&0&x_{23}&x_{24}&x_{25}\\x_{31}&0&x_{33}&x_{34}&x_{35}\\x_{41}&0&x_{43}&x_{44}&x_{45}\\x_{51}&0&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}x_{11}&0&x_{13}&x_{14}&x_{15}\\x_{21}&1&x_{23}&x_{24}&x_{25}\\x_{31}&0&x_{33}&x_{34}&x_{35}\\x_{41}&0&x_{43}&x_{44}&x_{45}\\x_{51}&0&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}x_{11}&0&x_{13}&x_{14}&x_{15}\\x_{21}&0&x_{23}&x_{24}&x_{25}\\x_{31}&1&x_{33}&x_{34}&x_{35}\\x_{41}&0&x_{43}&x_{44}&x_{45}\\x_{51}&0&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}x_{11}&0&x_{13}&x_{14}&x_{15}\\x_{21}&0&x_{23}&x_{24}&x_{25}\\x_{31}&0&x_{33}&x_{34}&x_{35}\\x_{41}&1&x_{43}&x_{44}&x_{45}\\x_{51}&0&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}x_{11}&0&x_{13}&x_{14}&x_{15}\\x_{21}&0&x_{23}&x_{24}&x_{25}\\x_{31}&0&x_{33}&x_{34}&x_{35}\\x_{41}&0&x_{43}&x_{44}&x_{45}\\x_{51}&1&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$	$=\frac{\begin{vmatrix}x_{11}&b_1&x_{13}&x_{14}&x_{15}\\x_{21}&b_2&x_{23}&x_{24}&x_{25}\\x_{31}&b_3&x_{33}&x_{34}&x_{35}\\x_{41}&b_4&x_{43}&x_{44}&x_{45}\\x_{51}&b_5&x_{53}&x_{54}&x_{55}\end{vmatrix}}{R}$
0 x_2 **0 1 0 0 0**	$=\frac{\begin{vmatrix}246&1&232&34&180\\3&0&14&3&2\\0,3&0&12&0,6&0,3\\60&0&14&12&23\\0&0&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}246&0&232&34&180\\3&1&14&3&2\\0,3&0&12&0,6&0,3\\60&0&14&12&23\\0&0&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}246&0&232&34&180\\3&0&14&3&2\\0,3&1&12&0,6&0,3\\60&0&14&12&23\\0&0&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}246&0&232&34&180\\3&0&14&3&2\\0,3&0&12&0,6&0,3\\60&1&14&12&23\\0&0&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}246&0&232&34&180\\3&0&14&3&2\\0,3&0&12&0,6&0,3\\60&0&14&12&23\\0&1&0,2&6&6\end{vmatrix}}{9.022.199,58}$	$=\frac{\begin{vmatrix}246&1.700&232&34&180\\3&55&14&3&2\\0,3&35&12&0,6&0,3\\60&275&14&12&23\\0&16&0,2&6&6\end{vmatrix}}{9.022.199,58}$
	$= 0,0005$	$= 0,0504$	$= -0,0641$	$= -0,0045$	$= -0,013$	$= 0,033$
0 x_3 0 0 1 0 0	$=\frac{\begin{vmatrix}x_{11}&x_{12}&1&x_{14}&x_{15}\\x_{21}&x_{22}&0&x_{24}&x_{25}\\x_{31}&x_{32}&0&x_{34}&x_{35}\\x_{41}&x_{42}&0&x_{44}&x_{45}\\x_{51}&x_{52}&0&x_{54}&x_{55}\end{vmatrix}}{R}$			$=\frac{\begin{vmatrix}x_{11}&x_{12}&0&x_{14}&x_{15}\\x_{21}&x_{22}&0&x_{24}&x_{25}\\x_{31}&x_{32}&0&x_{34}&x_{35}\\x_{41}&x_{42}&1&x_{44}&x_{45}\\x_{51}&x_{52}&0&x_{54}&x_{55}\end{vmatrix}}{R}$		$=\frac{\begin{vmatrix}x_{11}&x_{12}&b_1&x_{14}&x_{15}\\x_{21}&x_{22}&b_2&x_{24}&x_{25}\\x_{31}&x_{32}&b_3&x_{34}&x_{35}\\x_{41}&x_{42}&b_4&x_{44}&x_{45}\\x_{51}&x_{52}&b_5&x_{54}&x_{55}\end{vmatrix}}{R}$

$$= \frac{\begin{vmatrix} 246 & 187 & 1 & 34 & 180 \\ 3 & 28 & 0 & 3 & 2 \\ 0,3 & 8 & 0 & 0,6 & 0, \\ 0,3 & 0 & 0 & 12 & 23 \\ 0 & 0,2 & 0 & 6 & 6 \end{vmatrix}}{9.022.199,58} = -0,0001$$

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & 0 & x_{14} & x_{15} \\ x_{21} & x_{22} & 1 & x_{24} & x_{25} \\ x_{31} & x_{32} & 0 & x_{34} & x_{35} \\ x_{41} & x_{42} & 0 & x_{44} & x_{45} \\ x_{51} & x_{52} & 0 & x_{54} & x_{55} \end{vmatrix}}{R} = \frac{\begin{vmatrix} 246 & 187 & 1 & 34 & 180 \\ 3 & 28 & 0 & 3 & 2 \\ 0,3 & 8 & 0 & 0,6 & 0,3 \\ 0,3 & 0 & 0 & 12 & 23 \\ 0 & 0,2 & 0 & 6 & 6 \end{vmatrix}}{9.022.199,58} = -0,0348$$

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & 0 & x_{14} & x_{15} \\ x_{21} & x_{22} & 0 & x_{24} & x_{25} \\ x_{31} & x_{32} & 1 & x_{34} & x_{35} \\ x_{41} & x_{42} & 0 & x_{44} & x_{45} \\ x_{51} & x_{52} & 0 & x_{54} & x_{55} \end{vmatrix}}{R} = \frac{\begin{vmatrix} 246 & 187 & 1 & 34 & 180 \\ 3 & 28 & 0 & 3 & 2 \\ 0,3 & 8 & 0 & 0,6 & 0,3 \\ 0,3 & 0 & 0 & 12 & 23 \\ 0 & 0,2 & 0 & 6 & 6 \end{vmatrix}}{9.022.199,58} = 0,124$$

$$= \frac{\begin{vmatrix} 246 & 187 & 1 & 34 & 180 \\ 3 & 28 & 0 & 3 & 2 \\ 0,3 & 8 & 0 & 0,6 & 0, \\ 0,3 & 0 & 0 & 12 & 23 \\ 0 & 0,2 & 0 & 6 & 6 \end{vmatrix}}{9.022.199,58} = 0,0015$$

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & 0 & x_{14} & x_{15} \\ x_{21} & x_{22} & 0 & x_{24} & x_{25} \\ x_{31} & x_{32} & 0 & x_{34} & x_{35} \\ x_{41} & x_{42} & 0 & x_{44} & x_{45} \\ x_{51} & x_{52} & 1 & x_{54} & x_{55} \end{vmatrix}}{R} = \frac{\begin{vmatrix} 246 & 187 & 1 & 34 & 180 \\ 3 & 28 & 0 & 3 & 2 \\ 0,3 & 8 & 0 & 0,6 & 0, \\ 0,3 & 0 & 0 & 12 & 23 \\ 0 & 0,2 & 0 & 6 & 6 \end{vmatrix}}{9.022.199,58} = 0,0025$$

$$= \frac{\begin{vmatrix} 246 & 187 & 1.700 & 34 & 180 \\ 3 & 28 & 55 & 3 & 2 \\ 0,3 & 8 & 35 & 0,6 & 0, \\ 0,3 & 0 & 2 & 12 & 23 \\ 0 & 0,2 & 16 & 6 & 6 \end{vmatrix}}{9.022.199,58} = 2,7184$$

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & 1 & x_{15} \\ x_{21} & x_{22} & x_{23} & 0 & x_{25} \\ x_{31} & x_{32} & x_{33} & 0 & x_{35} \\ x_{41} & x_{42} & x_{43} & 0 & x_{45} \\ x_{51} & x_{52} & x_{53} & 0 & x_{55} \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & 1 & x_{15} \\ x_{21} & x_{22} & x_{23} & 1 & x_{25} \\ x_{31} & x_{32} & x_{33} & 0 & x_{35} \\ x_{41} & x_{42} & x_{43} & 0 & x_{45} \\ x_{51} & x_{52} & x_{53} & 0 & x_{55} \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & 1 & x_{15} \\ x_{21} & x_{22} & x_{23} & 0 & x_{25} \\ x_{31} & x_{32} & x_{33} & 1 & x_{35} \\ x_{41} & x_{42} & x_{43} & 0 & x_{45} \\ x_{51} & x_{52} & x_{53} & 0 & x_{55} \end{vmatrix}}{R}$$

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & 1 & x_{15} \\ x_{21} & x_{22} & x_{23} & 0 & x_{25} \\ x_{31} & x_{32} & x_{33} & 0 & x_{35} \\ x_{41} & x_{42} & x_{43} & 1 & x_{45} \\ x_{51} & x_{52} & x_{53} & 0 & x_{55} \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & 1 & x_{15} \\ x_{21} & x_{22} & x_{23} & 0 & x_{25} \\ x_{31} & x_{32} & x_{33} & 0 & x_{35} \\ x_{41} & x_{42} & x_{43} & 0 & x_{45} \\ x_{51} & x_{52} & x_{53} & 1 & x_{55} \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & b_1 & x_{15} \\ x_{21} & x_{22} & x_{23} & b_2 & x_{25} \\ x_{31} & x_{32} & x_{33} & b_3 & x_{35} \\ x_{41} & x_{42} & x_{43} & b_4 & x_{45} \\ x_{51} & x_{52} & x_{53} & b_5 & x_{55} \end{vmatrix}}{R}$$

0 x_4 0 0 0 1 0

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 1 & 180 \\ 3 & 28 & 14 & 0 & 2 \\ 0,3 & 8 & 12 & 0 & 0,3 \\ 60 & 0 & 14 & 0 & 23 \\ 0 & 0,2 & 0,2 & 0 & 6 \end{vmatrix}}{9.022.199,58} = -0,0091$$

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 0 & 180 \\ 3 & 28 & 14 & 1 & 2 \\ 0,3 & 8 & 12 & 0 & 0,3 \\ 60 & 0 & 14 & 0 & 23 \\ 0 & 0,2 & 0,2 & 0 & 6 \end{vmatrix}}{9.022.199,58} = 0,0328$$

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 0 & 180 \\ 3 & 28 & 14 & 0 & 2 \\ 0,3 & 8 & 12 & 1 & 0,3 \\ 60 & 0 & 14 & 0 & 23 \\ 0 & 0,2 & 0,2 & 0 & 6 \end{vmatrix}}{9.022.199,58} = 0,0942$$

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 0 & 180 \\ 3 & 28 & 14 & 0 & 2 \\ 0,3 & 8 & 12 & 0 & 0,3 \\ 60 & 0 & 14 & 1 & 23 \\ 0 & 0,2 & 0,2 & 0 & 6 \end{vmatrix}}{9.022.199,58} = 0,0351$$

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 0 & 180 \\ 3 & 28 & 14 & 0 & 2 \\ 0,3 & 8 & 12 & 0 & 0,3 \\ 60 & 0 & 14 & 0 & 23 \\ 0 & 0,2 & 0,2 & 1 & 6 \end{vmatrix}}{9.022.199,58} = 0,1221$$

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 1.700 & 180 \\ 3 & 28 & 14 & 55 & 2 \\ 0,3 & 8 & 12 & 35 & 0,3 \\ 60 & 0 & 14 & 275 & 23 \\ 0 & 0,2 & 0,2 & 16 & 6 \end{vmatrix}}{9.022.199,58} = 1,2783$$

0 x_5 0 0 0 0 1

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & 1 \\ x_{21} & x_{22} & x_{23} & x_{24} & 0 \\ x_{31} & x_{32} & x_{33} & x_{34} & 0 \\ x_{41} & x_{42} & x_{43} & x_{44} & 0 \\ x_{51} & x_{52} & x_{53} & x_{54} & 0 \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & 0 \\ x_{21} & x_{22} & x_{23} & x_{24} & 1 \\ x_{31} & x_{32} & x_{33} & x_{34} & 0 \\ x_{41} & x_{42} & x_{43} & x_{44} & 0 \\ x_{51} & x_{52} & x_{53} & x_{54} & 0 \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & 0 \\ x_{21} & x_{22} & x_{23} & x_{24} & 0 \\ x_{31} & x_{32} & x_{33} & x_{34} & 1 \\ x_{41} & x_{42} & x_{43} & x_{44} & 0 \\ x_{51} & x_{52} & x_{53} & x_{54} & 0 \end{vmatrix}}{R}$$

$$= \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & 0 \\ x_{21} & x_{22} & x_{23} & x_{24} & 0 \\ x_{31} & x_{32} & x_{33} & x_{34} & 0 \\ x_{41} & x_{42} & x_{43} & x_{44} & 1 \\ x_{51} & x_{52} & x_{53} & x_{54} & 0 \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & 0 \\ x_{21} & x_{22} & x_{23} & x_{24} & 0 \\ x_{31} & x_{32} & x_{33} & x_{34} & 0 \\ x_{41} & x_{42} & x_{43} & x_{44} & 0 \\ x_{51} & x_{52} & x_{53} & x_{54} & 1 \end{vmatrix}}{R} \quad = \frac{\begin{vmatrix} x_{11} & x_{12} & x_{13} & x_{14} & b_1 \\ x_{21} & x_{22} & x_{23} & x_{24} & b_2 \\ x_{31} & x_{32} & x_{33} & x_{34} & b_3 \\ x_{41} & x_{42} & x_{43} & x_{44} & b_4 \\ x_{51} & x_{52} & x_{53} & x_{54} & b_5 \end{vmatrix}}{R}$$

$$= \frac{\begin{vmatrix} 246 & 187 & 232 & 34 & 1 \\ 3 & 28 & 14 & 3 & 0 \\ 0,3 & 8 & 12 & 0,6 & 0 \\ 60 & 0 & 14 & 12 & 0 \\ 0 & 0,2 & 0,2 & 6 & 0 \end{vmatrix}}{9.022.199,58} \quad = \frac{\begin{vmatrix} 246 & 187 & 232 & 34 & 0 \\ 3 & 28 & 14 & 3 & 1 \\ 0,3 & 8 & 12 & 0,6 & 0 \\ 60 & 0 & 14 & 12 & 0 \\ 0 & 0,2 & 0,2 & 6 & 0 \end{vmatrix}}{9.022.199,58} \quad = \frac{\begin{vmatrix} 246 & 187 & 232 & 34 & 0 \\ 3 & 28 & 14 & 3 & 0 \\ 0,3 & 8 & 12 & 0,6 & 1 \\ 60 & 0 & 14 & 12 & 0 \\ 0 & 0,2 & 0,2 & 6 & 0 \end{vmatrix}}{9.022.199,58} \quad = \frac{\begin{vmatrix} 246 & 187 & 232 & 34 & 0 \\ 3 & 28 & 14 & 3 & 0 \\ 0,3 & 8 & 12 & 0,6 & 0 \\ 60 & 0 & 14 & 12 & 1 \\ 0 & 0,2 & 0,2 & 6 & 0 \end{vmatrix}}{9.022.199,58} \quad = \frac{\begin{vmatrix} 246 & 187 & 232 & 34 & 0 \\ 3 & 28 & 14 & 3 & 0 \\ 0,3 & 8 & 12 & 0,6 & 0 \\ 60 & 0 & 14 & 12 & 0 \\ 0 & 0,2 & 0,2 & 6 & 1 \end{vmatrix}}{9.022.199,58} \quad = \frac{\begin{vmatrix} 246 & 187 & 232 & 34 & 1.700 \\ 3 & 28 & 14 & 3 & 55 \\ 0,3 & 8 & 12 & 0,6 & 35 \\ 60 & 0 & 14 & 12 & 275 \\ 0 & 0,2 & 0,2 & 6 & 16 \end{vmatrix}}{9.022.199,58}$$

$$= 0,0091 \quad = -0,0334 \quad = -0,0962 \quad = -0,035 \quad = 0,0449 \quad = 1,2966$$

$z_j - c_j$	0	0	0	0	0	-1,0016	-0,9496	-0,876	-0,9649	-0,9551	

Based on Table 10, the value $z_j - c_j \leq 0$. Therefore, the solution has been optimized and continued to Phase 2.

Phase 2: Identify the optimal solution.

Based on Equation (5), the original purpose function is included in the following Table 11:

Table 11. Beginning of Phase 2 Two-Phase Quick Simplex Method

		1.605	3.150	225	750	1.800	
CB	**VB**	x_1	x_2	x_3	x_4	x_5	**NK**
0	z	0	0	0	0	0	9.138,5
1.605	x_1	0	0	0	0	1	3,1963
3.150	x_2	0	1	0	0	0	0,033
225	x_3	0	0	1	0	0	2,7184
750	x_4	1	0	0	0	0	1,2783
1.800	x_5	0	0	0	1	0	1,2966
	$z_j - c_j$	0	0	0	0	0	

Based on Table 11, the value $z_j - c_j \leq 0$of the solution is optimal. With the optimal value result is $x_1 = 3{,}1963; x_2 = 0{,}033; x_3 = 2{,}7184; x_4 = 1{,}2783; x_5 = 1{,}2966$ and $z = 9.138{,}5$.

4. Conclusion

Based on the results of the discussion, it can be concluded that the optimal solution using the Two-Phase Simplex Method and the *Two-Phase Quick* Simplex Method provides results in the number of raw materials consumed per meal by people *with Diabetes Mellitus*, namely rice as much as 3.1963 grams, fish as much as 0.033 grams, tempeh as much as 2.7184 grams, broccoli as much as 1.2783 grams, and bananas as much as 1.2966 grams with a minimum cost that must be spent per meal of Rp. 9,138.5. So that the *Two-Phase Quick* Simplex Method is more efficient than the Two-Phase Simplex Method because it is seen from the number of iterations carried out. The Two-Phase Simplex Method is 5 iterations and the *Two-Phase Simple* Simplex Method is 1 iteration.

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