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SOLVING LINEAR PROGRAM WITH SIMPLEX METHOD THROUGH APP CALCULATOR SIMPLEX

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Abstract

Since the simplex approach takes so long to work, many students make mistakes or are just not as cautious as they should be, there is a learning material to help them overcome this. The objectives of this article are to accomplish the work of engineering ideas in Linear Program courses, gain insight into the development of learning media in the Linear Program, and be able to run digital media. This study was conducted in several ways, including using a line of inquiry, the graph technique, the simplex method, and Geogebra. The results reveal that the simplex calculator is uncomplicated to use and that the calculator's solutions are presented gradually and clearly. It is intended that by using this simplex calculator, students will be eligible to function more quickly.

Keywords: *Linear Program, Simplex Method, Learning Media*

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INTRODUCTION

Linear programming is a part of mathematics that is used to find the optimum value of a linear inequality (Tanzimah, 2018). This science is very important to use in performing calculations to find the optimum value of linear inequality problems (Wahyuni, 2017). At the tertiary level, students generally learn linear program material in separate courses or inserted in other courses, such as mathematics courses. By studying linear programming material, students can perform calculations to optimize a case to obtain maximum profit.

The learning media that is built can visualize the problem of linear equations so that it can be seen that the variables that influence each other can be seen. Learning media is made interactively so that students can interact. Students can make changes to variables and see the results of the changes they make directly. This will make students more interested in studying linear programming material (Putri & Suryati, 2019).

Digital learning media is a medium in modern times where with the existence of digital learning media, learning will be more interesting, fun, and easy (Ernawati, 2016). The Simplex method is a method that can be used to solve managerial problems that have been formulated in advance into a linear programming mathematical equation that has a decision variable ranging from greater than or equal to 2 to multivariable (Indrawirawan et al., 2013). The work of the simplex method is very long so many students make mistakes or are less careful in doing it, there is a learning material to help them overcome this.

Formulation of the problem

1) What digital media can help in learning Linear programming with the Simplex method?
2) How to apply digital media.

Purpose

1) Completed idea-engineering tasks in Linear Program courses.
2) Adding insight into the development of learning media in the Liner Program.
3) Can run the digital media.

METHOD

Using the Search Line

The line probing method is a method commonly used in linear programming to determine the optimum value of a linear problem.

Pros : This method is easy to use and easy to understand.

Weaknesses : If use this method, the size of chart or picture must right.

Using the Graphics Method

The graphic method is one method that can be used to solve linear programming problems. This method uses a graphical approach in its decision-making, where all the constraint functions are made in one part of the image then the optimal decision is taken.

The Graphic Method consists of two phases, namely:

1. Determine the space/area of the solution that is *feasible*.
2. Determine the optimal solution from all points in the *feasible region*. There are two methods to identify the optimum solution, namely:
   a. Isoline Method
   b. Extreme Point Method

Pros : This method is easy to use and easy to understand.

Weaknesses : This method is limited to use for two decision variables, if you have more than two decision variables, this method cannot be used. In drawing the graph, it must be neat and have the same size.

Using the Simplex Method

The Simplex method is a method that can be used to solve managerial problems that have been formulated in advance into a linear programming mathematical equation that has a decision variable ranging from greater than or equal to 2 (two) to multivariable. In this method, we change the model into the form of a table, then perform mathematical steps into the table. These mathematical steps are a replication of the process of moving from one extreme point to another on the boundary of the solution region. However, unlike the graphical method, where we can easily find the best point among all the solution points, the simplex method moves from one solution to a better solution until an optimal solution is obtained.

To find the optimum value using the simplex method, an iteration process is carried out starting from a feasible initial basis completion (Feasible) to a feasible final basis completion where the value of the objective function is optimum. In this case, the iteration process cannot be carried out again.

Pros : It would be better to use if more than 2 variables and 2 equations

Weaknesses : The road used is too long and seems complicated

Using Geogebra

Linear programming is a linear equation optimization model that deals with linear inequality problems. The linear programming problem means the problem of the optimum value (Maximum or minimum) of a linear function on a system of linear inequalities that must satisfy the optimization of the objective function.

Geogebra is very helpful in solving linear programming problems, of course, by not neglecting the mathematical steps in solving them. Geogebra can be used when starting to draw graphs and determining completion test points, as well as testing the optimum function at these points.

Pros : This method is easy to use and looks more attractive.

Weaknesses : This method can only be used in 2 to 3 variables.

RESULTS AND DISCUSSION

Using the Simplex Method manually

Maximize:

1. Purpose function:

$$Z = 30x_1 + 40x_2 \rightarrow \max\ Z - 30x_1 - 40x_2 = 0$$

2. Constraint function:
   a. Silk thread : $3x_1 + 4x_2 \leq 120 \rightarrow 3x_1 + 4x_2 + s_1 \leq 120$
   b. Wool yarn : $x_2 \leq 20 \rightarrow x_2 + s_1 \leq 20$
   c. Years of service : $2x_1 + 2x_2 \leq 40 \rightarrow 2x_1 + 2x_2 + s_1 \leq 40$

Putting Equations into a Table

NB	X_1	X_2	s_1	s_2	s_3	**Right Value**	**Index**
Z	-30	-40	0	0	0	0	
s_1	3	4	1	0	0	120	
s_2	0	1	0	1	0	20	
s_3	2	2	0	0	1	40	

Setting the Key Column

The key column is the column that has a negative base Z value with the largest number.

NB	X_1	X_2	s_1	s_2	s_3	**Right Value**	**Index**
Z	-30	-40	0	0	0	0	
s_1	3	4	1	0	0	120	
s_2	0	1	0	1	0	20	
s_3	2	2	0	0	1	40	

Define Key Row

Defining the key row as the smallest index value by below formula:

$$\text{Index} = \frac{Right\ Value\ (RV)}{Key\ Column\ Value}$$

NB	X_1	X_2	s_1	s_2	s_3	**Right Value**	**Index**
Z	-30	-40	0	0	0	0	-
s_1	3	4	1	0	0	120	30
s_2	0	1	0	1	0	20	20
s_3	2	2	0	0	1	40	20

Specifying New Key Row Value

New key row = key row/key number

So, the table becomes as follows:

NB	X_1	X_2	s_1	s_2	s_3	**Right Value**	**Index**
Z							
s_1							
s_2							
X_1	1	1	0	0	1/2	20	

Changing Values Other Than Key Row

New row = old row – (key column value * new key row value)

Z	-30	-40	0	0	0	
-	0					
40	1	1	0	0	½	
	20 -					
10	0	0	0	20	800	

s_1	3	4	1	0	0	
	120					
4	1	1	0	0	½	
	20 -					
-1	0	1	0	-2	40	

s_2	1	1	0	1	0	
	20					
1	0	1	0	0	½	
	20 -					
-1	0	0	1	-½	0	

Enter New Row Value

NB	X_1	X_2	s_1	s_2	s_3	**Right Value**	**Index**
Z	10	0	0	0	20	800	

s_1	-1	0	1	0	-2	40
s_2	-1	0	0	1	-1/2	0
X_2	1	1	0	0	1/2	20

The results are = 20, Zmax = 800

Using the Simplex Calculator

In finding the maximum and minimum value of a linear programming problem using the simplex method, many students still cannot use it and still make mistakes/errors in using this simplex method, because the simplex method is a very long way of working and typing. Students may miscalculate so that the answer they got would be wrong, so to overcome this, the student had to check the simplex method several times, which took a very long time.

Here the researchers offer a solution to overcome student's errors in working on a linear programming system by using an application. The application is "Simplex calculator", where this application can be downloaded on student smartphones. It is uncomplicated to use; here the researchers will show the way to use this application:

For example:

Maximize:

$Z= 30x_1+40x_2$

Constraint function:

$3x_1+4x_2 \leq 120$

$x_2 \leq 20$

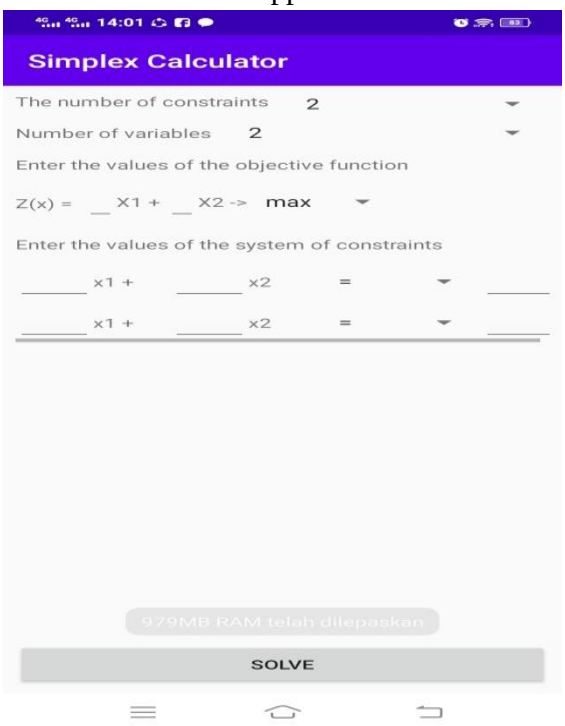
$2x_1+ 2x_2 \leq 40$

The steps for working on the problem above using a simplex calculator are:

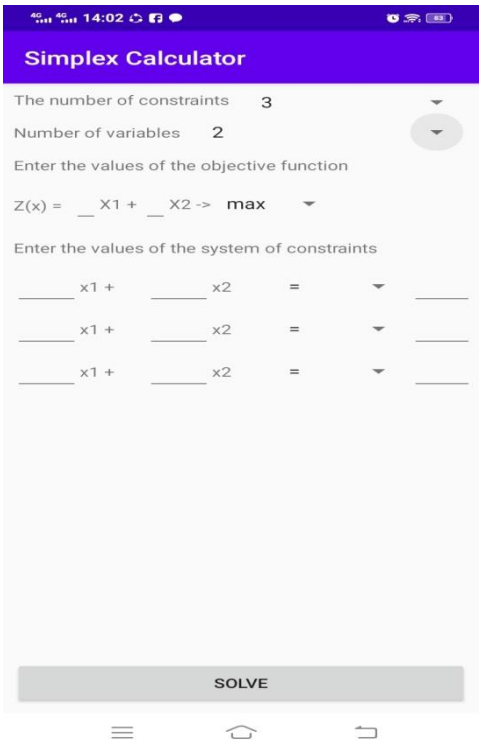
1. Download the Simplex application "Method Calculator" on the play store.



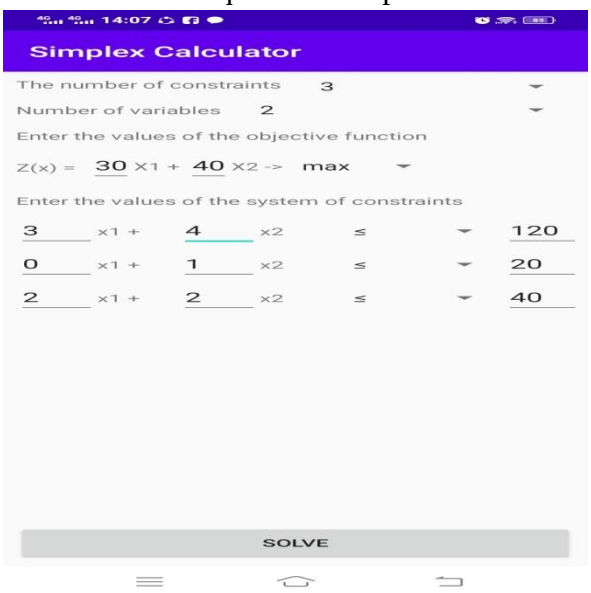
2. Open the Simplex Method Calculator App.



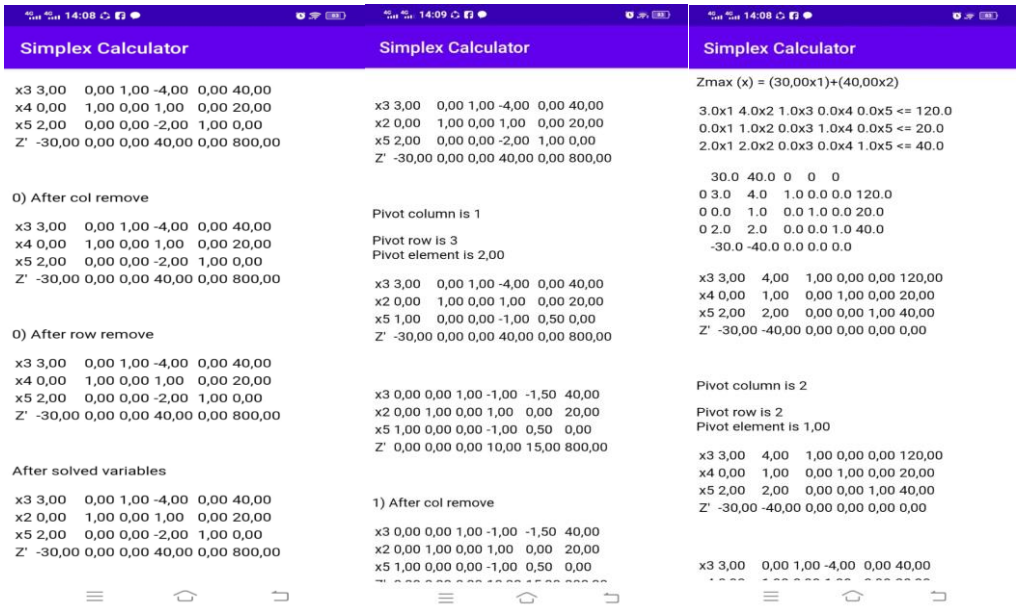
3. Adjust the App with the number of variables and the functions of the problem. The data problem consists of 2 variables namely X_1 and X_2 consists of 4 equations where 1 equation is the objective function and 3 equations are the constraint function.



4. Enter the constant values of each equation then press solve and wait for the result.



Results:



From the results above, it can be concluded that the maximum value of the above function is 800, and the value x_1=20 and x_2=40

The Advantages of the App are:

1. Easy to use
2. Help students overcome errors in using the simplex method

The Disadvantage of the App is:

This app can only up to 20 variables and 20 equations.

CONCLUSION

The simplex calculator is very easy to use and the answers shown by the calculator are shown in stages and clearly. With the simplex calculator, it is hoped that students will be able to understand the simplex method more quickly and better.

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