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LINEAR PROGRAM MODEL FOR PROFIT OPTIMIZATION IN MEATBALL SALES USING GRAPH METHOD

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ABSTRACT

The production process is an important thing that can affect profits. The production process also needs to be considered to increase profits to be more optimal. This optimization problem is still an obstacle for most businesses, one of which is the sale of meatballs with the owner of Bakso Bang Riski and Tante Juli located on Jl. Lapangan Golf Tuntungan. This study aims to optimize profits on meatball sales through the application of linear program models with the graph Profit Optimization, Linear Program method. In the sale of meatballs studied using meat and flour raw Model, Graph Method materials to produce 200 servings of meatballs per day with a price per serving of Rp. 5000 and an average income of Rp. 200,000 per day. This research uses a qualitative approach with descriptive analysis, developing mathematical models in the form of decision variables, objective functions, and constraint functions. The analysis results show that the graph method is effective in maximizing profits, with a maximum income of Rp4,000,000 per month and a profit of Rp3,800,000 or 80% of the total initial income. This method provides a practical solution for MSME players to improve production efficiency and business profits through a mathematical approach.

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1. **INTRODUCTION**

In Indonesia, the Small and Medium Enterprise (SME) sector is growing rapidly and dominates the business category, with 64 million SMEs accounting for 99.9% of all businesses. In the era of globalization, industries including culinary and processed food products have made significant progress. This encourages businesses to improve competitiveness and production efficiency, even though they face the challenge of limited resources. The concept of operations research is widely applied in economics and business, especially for economic principles that generate significant profits with minimal capital. In the context of business, optimization is essential to improve a company's performance and competitiveness. This process involves an in-depth analysis of various variables that affect operations, such as resources, costs, and time. Through a systematic approach, companies can determine the best strategy to achieve their desired goals. Optimization is not only useful for large companies, but it is also very relevant for Micro, Small, and Medium Enterprises (MSMEs). By applying optimization principles, MSMEs can manage resources more efficiently and increase profitability. Thus, optimization plays an important role in making better decisions and contributing to sustainable economic growth (One of the models that can be used for optimization is the optimization model. (Sumantri, Nugraha, Adji, & Paduloh, 2025). The uniqueness of Indonesian culture cannot be separated from its people, especially in the culinary field.

Bakso is a typical Indonesian food and is popular among the people. Not only does it taste good, but the price is also very affordable. Therefore, this meatball can be enjoyed by the upper and lower classes. Mathematics itself is also one of the sciences that has a big role in everyday life in the development of science and technology. As a tool to help study the problems faced in the economic field is the role of mathematics which is useful because it can be stated briefly and clearly. Examples of the application of mathematics in economics include using linear programming with graphical methods in optimization calculations on food production. (Humairoh, Sabillah, Ramadani, Kobak, Masuwara, & Sutejo, 2024). There are many foods that we can make as subjects for research, one of which is meatballs. Bakso is one of the processed meat-based snacks that is favored by many people. This material is generally made from chicken meat, and almost 75.78% of chicken meat is used as raw material for making meatballs. One of the foods regulated in SNI is meatballs. SNI offers a large selection of meatball products with varying quality. One of the parameters commonly used to determine whether a meatball product is good or bad is its toughness. Meatballs like a chewy texture, not hard Factors that affect the texture of meatballs include meatball ingredients, manufacturing process, and cooking time. Meatballs are generally made from meat and tapioca flour. (Kartikasar, Hertanto, Pamungka, Saputri, & Nuhriawangsa, 2020)

Initially, linear programs were developed to plan expenses and income in order to reduce losses for soldiers and increase losses for the enemy (World War II). However, until now linear programming continues to develop to help any business minimize losses on any activity that expends capital, for example MSME businesses. Linear programming, also known as linear optimization, is a program commonly used to solve optimization problems. The linear optimization value is obtained from the value in a set of linear problem solutions. While the constraints or constraints can be translated in the form of a system of linear inequalities. (Rina Gebryella Gultom, 2024)

Linear programming is a technique that uses mathematical models to make decisions and achieve optimal goals with limited resources with the aim of getting optimal results, an optimization process used in linear programs maximizes profits and minimizes costs. . (Puja, Fu'adin, Azahara, Hari, Hafizh, & Salsa, 2023) The general form of mathematical modeling in linear programs can be described as follows (Lalang, Loban, Adrianigsih, & Djenlau, 2023): 1. Objective Function Description : = Liner Objective Functions = Known Constants = Decision Variable = Integers 1. Constraint Function To maximize the objective function To minimize the Objective Function Description : = Known Constant = Integers

The problem of linear programming, among others, is pricing in accordance with the goal of making the work objectives more ideal, efficient, or effective by considering the current emergency situation, including problems related to determining the strength of each element. After the research case is identified, a solution is needed, which first needs to be analyzed how production should be carried out so that production can be maximized. One of the production analysis methods that can be used is a linear program using graphical techniques. The method used from the linear program is the graph method. In completing the graph method using 2 solution methods, namely (Huwaida H. , 2020) 1. Elimination Method In this elimination method, determine the solution of variable variabel by eliminating variable , and to determine the solution of variable , by eliminating variable 2. Substitution Method Substitution Method of Two-Variable Linear Equation System In the substitution method, the first step is to change one of the equations into a function equation, namely as a function of or as a function of . Then substitute or in the other equation.

By analyzing with this graphical method, the production of meatballs at ordinary meatball stands is not arbitrary, but is thoroughly analyzed, so that it affects the effective and efficient use of materials, thereby affecting production and income will increase. For example, production increases significantly, thereby increasing revenue or profit.

2. RESEARCH METHOD

This research uses a qualitative method using a graphic approach. Qualitative research is descriptive in nature which uses analysis that emphasizes the process and meaning of research based on theories that can be used as a benchmark so that the concentration of researchers matches the truth in the field. This research was conducted by applying mathematical modeling, namely linear programs. Then the graphical method used is a solution to linear program problems, especially those with two variables. However, in this problem the researcher chose the graphical method as a way to solve the profit optimization problem. This method requires writing the constraint function and the objective function. These functions become equations and inequalities. The presentation of data is made to find out how to calculate profit using the mathematical concept of graphical method

3. RESULT AND ANALYSIS

The meatball sales studied are one of the UMKM with the Owner, Bakso Bang Riski and Tante Juli, which is located on Jl. Tuntungan Golf Course and this business has been open for 1.5 years. The meatballs sold by the seller are Rp. 5,000 per serving. Meatball sellers use 20 kg of meat and 10 kg of flour to produce 200 portions / day. Then the production process is carried out by 5 workers and 7 cooking tools in a maximum working time of 90 minutes. The seller earns around Rp. 200,000 per day from the sales. This UMKM is a business or merchandise that is quite in demand because of its strategic location close to residential areas and the UINSU Tuntungan campus so that automatically there are many customers from among UINSU students who not only come to campus but those who live in boarding houses.

Decision Variable x = Meat Meatballsy = Mercon Meatballs **Objective Function** Zmax = Rp. 5.000x + Rp. 200.000y**Constraint Function** Constraint 1 (Meat and flour raw material limitation) $20x + 10y \le 200$ Constraint 2 (Constraints on worker time and cooking tools) $5x + 7y \le 90$ Finding the intersection point Finding the intersection point 5x + 7y = 9020x + 10y = 200Example: x = 0Example: x = 07y = 9010y = 200y = 20y = 12,85(0.20)(0,12,85) Suppose: y = 0Suppose y = 020x = 2005x = 90x = 10x = 18(10,0)(18.0)

Application of Graph Method

Application of Graph Method

The graph method is one of the methods used to solve linear program problems in which there are two decision variables. The graph method can be used to obtain the ptimum value of a function, but this method is limited to two decision variables.

Steps for solving with the graph method

- 1. Create a mathematical model in the form of decision variables, objective functions, and constraint functions.
- 2. Change each constraint function into an equation form
- 3. Create a graph for each constraint function
- 4. Determining the solution area and the corner points contained in the graph
- 5. Find the optimum value by testing each corner point.

Known mathematical model

- Decision Variable
- x = Meat Meatballs

y = Mercon Meatballs

Objective Function

 $Z_{max} = Rp. 5.000x + Rp. 200.000y$

Constraint Function

a. Constraint 1 (Limitation of meat and flour raw materials) $20x + 10y \le 200$

Constraint 2 (Time constraints of workers and cooking equipment)

 $5x + 7y \le 90$

Transforming the constraint function form into an equation

20x + 10y = 200

5x + 7y = 90

b.

Graph the constraint function



Figure 1 The graph of constraint function

The intersection points in the solution area are; (10,0) and (0,20) Test the corner points to the objective function Objective Function f(x) = 5,000x + 200,000y

- 1. Point (10,0)
 - 5000 (10) + 200000 (0) = Rp. 50,000

This means that if the meatball seller sells 10 bowls of meatballs, he will get a revenue of Rp. 50,000. one day's sales are Rp. 200,000, so the meatball seller loses Rp. 150,000 for one day.

2. Point (0,20)

5000 (0) + 200000 (20) = Rp. 4,000,000

This means that if the sale of meatballs reaches 20 bowls of mercon meatballs, it will generate revenue of 4,000,000. Therefore, the seller gets a profit of Rp. 3,800,000.

Based on the test results of the two corner points, the maximum income for selling meatballs is obtained for one day and earns Rp. 4,000,000 with a profit of Rp. 3,800,000 or 80% of the initial income.

4. CONCLUSION

This study aims to determine the profit from the sale of meatballs in Tuntungan. Meatballs sold at a price of 5000 / portion can produce 200 portions / day. The income earned by the seller per day is around 200,000 the method used is qualitative and the model used is the graph method where the graph method is used to solve linear program problems in it. The way to make the graph method is to make a mathematical model in the form of decision variables, objective functions, constraint functions. After that, change the function form into an equation form and make a graph for each constraint. Determine the solution area and corner points contained in the graph. The results obtained through the graph method provide maximum income for 1 month. Rp. 4 million. With a profit of three million eight hundred or 80 percent of the initial income. And this research provides an overview to meatball sales to calculate sales profits with mathematical concepts.

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