Optimizing Production Planning for Tempe Babe Within Goal Programming Method

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Abstract. Production planning is the most important part of the production process in Tempe Babe. The material consideration in the production planning in this research is the optimizing of the amount of production in fulfilling the number of Tempe demand, optimizing of the amount of profit Tempe obtained and the minimization of the amount of raw materials used for Tempe production. The implementation of the goal programming method can provide solutions for optimizing production planning on Tempe Babe, where the deviational variables in goal programming serve to demonstrate the possibility of negative and positive deviations from right side value of the destination function. The results of calculation analysis with goal programming, indicating the excess amount of product production will be added to the product that has the biggest advantage and the excess amount of production will be added to the product that has the number of requests. Optimal profit from each product resulting in the amount of prediction of Tempe production. The results of this research provide the optimum solution for production planning on Tempe Babe every month. In addition, this study also resulted in a new mindset to find production planning models in the IoT environment as a continuation of this research.

Keywords: Production Planning, Tempe Babe, Goal Programming, optimization

1. Introduction

Production planning is part of operational planning within the company. Production planning is a plan about the number and type of products that the company will produce in a given period [3]. Some things to consider in drafting production planning are product optimization problems that can reduce production costs so that the low production cost levels can be achieved for production processes [4]. Product optimization in this case is maximising production volumes to meet demand, maximize profitability, and minimize the use of raw materials.

Tempe Babe is a business engaged in producing tempeh. When the demand for Tempe increases, Tempe Babe will also increase the amount of Tempe production as expected. Tempe Babe wants the amount of Tempe produced can fulfill all the demands, so that the gains gained also increase. The increasing number of tempeh is produced, resulting in increased raw materials used. The raw material supply to make tempeh owned by Tempe Babe is limited, so Tempe Babe wants a minimum use of raw materials but can still meet all consumer demand.

There are a number of destinations that Tempe Babe wants to achieve, which is maximizing profits, meeting all requests by minimizing the use of raw materials available. With this condition, it
takes a mathematical model that can find its optimal solution. One of the mathematical models that can be used in production planning with some objectives is goal programming. This method of goal programming can be used for problems that have many goals. The goal programming method is able to provide an effective solution to the objectives that have been established [8]. This method is an extension of linear programming, where linear programming is only able to solve the problem with a single purpose while the goal programming is able to solve problems with multiple objectives [9].

2. The problem

The problem formulation in this research is how to optimize the limited resources (raw materials) of existing production in Tempe Babe using goal programming method.

3. Production Planning

Production planning is planning about what product and how many companies will be manufactured in a future period. Production planning is part of operational planning within the company[2]. Production planning is a very important part. Because the industry is often faced with complex problems in taking a decision to maximize the company's profit, so the company strives to maximize production volume in order to meet the number of requests Making optimal production planning [5].

In the preparation of production planning, the need to be considered is the production optimization so that it will be achieved the lowest cost level for the implementation of the production process [1]. This research makes the concept of optimization of production planning using goal programming method which is able to provide predictions on the production of Babe Tempe. Completion of goal programming using simplex method resulting in the production planning of Tempe Monthly.

4. Data Analysis

The Data used in this research is the amount of Tempe production, the number of Tempe requests, the profit amount of each Tempe, the amount of raw materials used to make tempeh and the amount of raw material availability.

Data collection is done by interview and direct observation. The interview was done by asking the owner Tempe Babe. The Data obtained from the interview are the amount of raw materials used to make tempeh and the price of each raw material used. To strengthen the results of interviews conducted direct observation of the amount of tempeh produced or the availability of raw materials used.

a. Analisis Goal Programming

Goal programming is applied to linear problems by incorporating various objectives in the model formulation. Each goal is expressed as a goal and is presented numerically. This numerically stated Goal is what it tries to accomplish [10]. Various goals are not always achievable at the same time because there can be deviation from the goal, so that in the formulation of goal programming, the goal in numerical for each goal must be set first. Then, the solution to be sought is to minimize the number of deviations of each goal against each of the goal [6].

Analysis of the goal programming method for the production planning of Tempe on Tempe Babe as follows:
1. Formulating the target constraints function
   In drafting a programing goal first must be specified a decision variable from the optimization model, then formulate the constraints function, and the function of the goal to be achieved.
   a. Specifying decision variables
      The decision variable in this issue is the production amount of each type of Tempe.
      \[ X_i = \text{Total Production of the product to-}i \]
\[ i = \text{Product type is generated } i=1,2,3,4. \]
\[ X_1 = \text{Total production of Tempe 10x} \]
\[ X_2 = \text{Total production of Tempe 15x} \]
\[ X_3 = \text{Total production of Tempe 20x} \]
\[ X_4 = \text{Total production of Tempe 25x} \]

b. Formulation of constraint function

In this study, there are several goals or objectives that want to be achieved to assist decision makers in making production planning, these objectives include:

Maximize production volume to meet the number of requests

The formulation of target constraints function maximizes production volumes to meet the number of requests is as follows:

With:

\[ X_I = \text{number of products I produced} \]
\[ P_I = \text{Product Request Level I} \]
\[ DB_I = \text{deviation value under } P_I \]
\[ DA_I = \text{deviation value above } P_I \]

The formulation of target constraints function above can be used as follows:

\[ X_1 + DB_1 - DA_1 = 625 \]
\[ X_2 + DB_2 - DA_2 = 547 \]
\[ X_3 + DB_3 - DA_3 = 591 \]
\[ X_4 + DB_4 - DA_4 = 585 \]

In this case, the desired goal of Tempe Babe is to maximize the volume of production, hence the negative deviation (shortage of production amount) is zero so that the negative deviation should be

- Maximize profits

The base price for the manufacture of each Tempe varies because it uses a different amount of soybean depending on the size of Tempe. By taking into account the number of Tempe requests, the estimated amount of profit to be achieved can be calculated as follows:

Projection Advantage:

\[ \sum U_i x_i \quad 4 \quad i=1 \]

\[ U = \text{Profit for 1 seed Tempe} \]
\[ x = \text{number of Tempe requests} \]
\[ i = \text{Type Tempe} \]

Then the projection gains:

Projected gains \[ = (\text{Rp.650x260})+(\text{Rp.613x180})+(\text{Rp.659x120})+(\text{Rp.653 x20}) \]
\[ = \text{Rp. 371,480} \]

The equation of function for projection gains is:

\[ 650X_1 + 613X_2 + 659X_3 + 653X_4 \geq 371,480 \]

In this case, the target of Tempe Babeis maximizing profit. Thus, it is expected that negative deviations (gains under the projected profit) are cultivated zero so that negative deviations (DB) must be minimized. Thus, the target constraint function for this function is: \[ 650X_1 + 613X_2 + 659X_3 + 653X_4 + DB_5 - DA_5 = 371,480 \]

- Minimize raw material usage

The use and availability of raw materials as a function constraint is to see the relationship between usage and the availability of raw materials with the number of products produced. The amount of raw materials for each product must be smaller or equal to the availability of these materials. The formulations used are: \[ \sum \sum B_l x_i \leq B_l \quad 4 \quad i=1 \quad 12 \quad l=1 \]
In this case, the goal of Tempe Babe is minimizing the use of raw materials. So, it is expected that a positive deviation (excess raw material) is cultivated zero so that positive deviation (DA) must be minimized. Thus, the target constraint function for this function is:

$$0.00429X_1 + 0.00429X_2 + 0.00375X_3 + 0.00375X_4 + DB_6 - DA_6 = 100$$
$$0X_1 + 0X_2 + 0.00435X_3 + 0.00435X_4 + DB_7 - DA_7 = 100$$
$$0.001X_1 + 0.001X_2 + 0X_3 + 0X_4 + DB_8 - DA_8 = 30$$
$$0X_1 + 0X_2 + 0.00088X_3 + 0.00088X_4 + DB_9 - DA_9 = 45$$
$$0.00975X_1 + 0.01116X_2 + 0.00280X_3 + 0.00280X_4 + DB_{10} - DA_{10} = 75$$
$$0.00530X_1 + 0.00530X_2 + 0X_3 + 0X_4 + DB_{11} - DA_{11} = 75$$
$$0.00008X_1 + 0.00022X_2 + 0.00217X_3 + 0.00220X_4 + DB_{12} - DA_{12} = 30$$
$$0.00026X_1 + 0.00048X_2 + 0.000308X_3 + 0.000308X_4 + DB_{13} - DA_{13} = 17$$
$$0X_1 + 0.000035X_2 + X_3 + 0X_4 + DB_{14} - DA_{14} = 0.5$$
$$0X_1 + 0X_2 + 0.00024X_3 + 0X_4 + DB_{15} - DA_{15} = 6.75$$
$$0X_1 + 0X_2 + 0X_3 + 0.00006X_4 + DB_{16} - DA_{16} = 2$$
$$0X_1 + 0X_2 + 0X_3 + 0.00035X_4 + DB_{17} - DA_{17} = 5$$

In order for DA equation above the minimum, then the goal function equation becomes:

$$\text{Min } Z = \sum DA_i \text{ i=6}$$

2. Formulating Goal Programming formulation

Based on the objectives—the goal that Tempe Babe wants to achieve is:
- Maximize production Volume
- Maximize profits
- Minimize the use of raw materials and goal programming formulation

b. Solutions with the Simplex method

Production planning of tempeh on Tempe Babe using simplex method is as follows [7]:

1st iteration:
- The first step is to calculate the Zj value.
- The next step is to calculate the value of Cj-Zj. Once the Cj-Zj value is obtained, the next step is to see if the table is optimum. Table is optimal if the value of Cj-Zj ≥ 0 for the entire J. If the table is not optimal then the Cj-Zj value that has the largest negative value is selected as the key column. In this case, the X3 column is the key column.
- Once the key column is obtained, the next stage is selecting the key row. The key line is obtained from the row that has the smallest ratio value and the ratio value should be greater than zero.
- The next stage is to swap the base value on the key row with the decision variable on the key column.

2nd Iteration:
- The first step is to replace the DB3 base variable with the X1 decision variable. In the 1st Iteration simplex table The key element is a coefficient of X1 in line 1, so in the iteration table to 2 the key coefficient of the element should be 1, whereas for the coefficient of X1 in the other row, which is not the key element must be 0.
- In the second iteration and the next iteration of the step used is the same as the 1st iteration, which is calculating the Zj, Cj-Zj value, looking for the Cj-Zj value that has the largest negative value. Calculations are carried out until optimum table.

5. Result

Based on settlement using simplex method obtained the optimal solution because the whole Cj-Zj ≥ 0. Thus the optimum solution for production planning is Tempe Babe produces each month as follows:
- Production of Tempe X1 as much as 6000 Tempe
- Production of Tempe X2 as much as 5800 Tempe
- Production of Tempe X3 as much as 5700 Tempe
- Production of Tempe X4 as much as 5200 Tempe

This research resulted in a framework of thought for the development of the results of this research, where production optimization will be applied according to the needs in the IoT environment. The framework is produced as follows:

![Framework Image](image)

Based on the image above this study will be developed with a big data scope that requires a more complex model. The research was developed to find a production planning model in the IoT environment by developing methods from previous research to find new methods for production planning model completion in the IoT environment. The use of IoT technology is expected to improve production planning, as it will be able to produce more directional and realtime planning.

6. Conclusions

The research of production planning optimization on Tempe Babe using the goal programming method can provide information to predict the amount of Tempe production each month. The results of this research provide the optimum solution for production planning on Tempe Babe every month. In addition, this study also resulted in a new mindset to find production planning models. The NEW mindset of this study will be developed in subsequent research by developing methods from previous research to find new methods for completion of production planning models in the IoT environment.

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