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A Linear Programming Approach in Profit Maximization for Food Production

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Abstract: Nowadays, the prices of raw materials to produce frozen food is increase due to many factors such as economy, politics and technological development. Therefore, RSS Delek company which produced frozen foods has to spend wisely to ensure that the company manage to maximize profits. The objective of this study is to determine the number of each type of frozen food should be produced in order to maximize profits. Linear programming is used to model the data and the model solved by using MS Excel. Result showed that the company should produced two packs of karipap, one packs of apam, one packs of pau, and three packs of cucur badak daily and profit increase 100%.

Keywords: Linear Programming, Mathematical Model, Optimization, Solver.

1. Introduction

Delek Frozen Food company sells a variety of homemade frozen foods such as karipap, apam, keria, pau and cucur badak. Currently, they produced each product due to limited raw materials and demand. Sometimes they faced with zero demand. In average, the profit gained by the company is RM15 daily which is low and not worth if compared to the cost of raw materials. Linear programming was introduced to the company because this method can help the management of the company to make a decisions

Akpan et al. (2016) also conducted a research on Application of Linear Programming for Optimal Use of Raw Materials in Bakery. He also used the simplex method algorithm, a component of linear programming, to allocate raw materials to competing variables (big loaf, giant loaf, and small loaf) in the bakery in order to maximise profit. The analysis was performed, and the results revealed that 962 units of small loaf, 38 units of big loaf, and 0 units of giant loaf should be produced in order to make a profit of N20385. According to the analysis, the small loaf, followed by the big loaf, contribute objectively to the profit. The researcher came to the conclusion and recommendation that more small and large loaves be produced and sold in order to maximise profit.

2. Methodology

Data was collected from interview session with the manager of the company. Then the data is modelled by using linear programming approach. Linear programming is one of the optimization techniques used widely to solve managerial decision-making problems (Oluwaseyi et al., 2020). Linear programming help to find optimal solution such as maximize profit or minimize cost. A typical example would be determining the best production levels for maximum profits under given material and labour constraints.

According to Yahya et. al 2012, linear programming models are frequently used in operation research and management science to solve problems concerning to limited resources. They used linear programming approach in a product-mix company in selecting

the best medicated soap to sell in order to maximize profit. The result showed the company should sell one tablet per pack of their medicated soap product to achieve maximum profit about N271,296.

The general linear programming model with *n* decision variables and *m* constraints can be stated in the following form.

$$\max \ c_1x_1 + c_2x_2 + ... + c_nx_n$$

subject to linear constraints

$$\sum_{j=1}^{n} a_{ij}x_j \leq b_i$$

Where ,

$c_1, c_2, ..., c_n$ represent the profit of decision variables.

a_{ij} represent the amount of resources of decision variables.

b_i represent the availability of i^{th}resources.

The following table 1 represent the profit of each type of frozen food and the amount of raw materials needed to producefrozen food.

Table 1: Profit and amount of raw materials

	Frozen food					
	Karipap (x_1)	Apam (x_2)	Pau (x_3)	Keria (x_4)	Cucur Badak (x_5)	
Proft (RM)	3	3.5	2.5	2	4	Limitation (gram)
Flour (gram)	500	130	135	200	420	5000
Yeast (gram)	0	11	11	0	0	100
Sugar	0.1	125	60	150	26	800
Butter	0.5	0	720	0	0	2000
Condensed milk	0	0	30	0	0	100
Salt	0.0011	0.0009	0	0.001	0.004	8
Dry shrimp	0	0	0	0	100	300
Potato	900	0	0	650	250	2300
Rice	0	370	0	0	0	500
Coconut	0	500	0	0	600	3000

Hence, based on the data collected, linear programming model is developed.

Definition of variables.

x_1 = the number of karipap should be produced.
x_2 = the number of apam should be produced.
x_3 = the number of pau should be produced.
x_4 = the number of keria should be produced.
x_5 = the number of cucur badak should be produced.

$$\max 3x_1 + 3.5x_2 + 2.5x_3 + 2x_4 + 4x_5$$

subject to

$$\begin{aligned}
500x_1 + 130x_2 + 135x_3 + 200x_4 + 420x_5 &\le 5000 \\
11x_2 + 11x_3 &\le 100 \\
0.1x_1 + 125x_2 + 60x_3 + 150x_4 + 26x_5 &\le 800 \\
0.5x_1 + 720x_3 &\le 2000 \\
30x_3 &\le 100 \\
0.0011x_1 + 0.0009x_2 + 0.001x_4 + 0.004x_5 &\le 8 \\
100x_5 &\le 300 \\
900x_1 + 650x_4 + 250x_5 &\le 2300 \\
370x_2 &\le 500 \\
500x_2 + 600x_5 &\le 3000 \\
x_1, x_2, x_3, x_4, x_5 &\ge 0
\end{aligned}$$

3. Result and Discussion

The linear programming model then solve by using Excel Solver which gives an optimal solution as follows. $x_1 = 2, x_2 = 1, x_3 = 1$ and $x_5 = 3$ and maximum profit received is RM30.

Based on the result, The objective of the study is achieved. Delek Food Frozen should produced two packs of karipap, one pack of apam, one pack of pau and three packs of cucur badak daily in order to maximize their profit. By using linear programming approach, profit increase from RM15 to RM30 daily. The profit increased by 100%.

4. Conclusion

The finding of this study revealed that linear programming approach is one of the best method for optimization problem. The company can increase their profit 100% with limited raw materials if they produce the recommended number of product such as two packs of

karipap, one pack of apam, one pack of pau and three packs of cucur badak daily. The result could help a decision maker to make a good decision in production line.

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