

*CONFERENCE PROCEEDING*

## **Applications of Linear Programming on Diet Problem for Burger King's Sets Menu in Malaysia**

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### **ABSTRACT**

The prevalence of fast food consumption has risen significantly over the past few decades, leading to concern regarding its impact on public health. Burger King, as one of the major fast-food chains, offers set menus that have gained immense popularity among consumers. However, these set menus are often criticized for their potential contribution to an unhealthy diet due to their high calorie, fat, and salt content. This research aims to tackle the diet problem associated with Burger King set menus in Malaysia using linear programming, with the goal of optimizing the nutritional content while adhering to dietary constraints. The aim of this research is to maximize the requirement calorie intake, reducing carbohydrate, salt, sugar, fat, and protein, while satisfying the requirement of nutrition. The diet problem in this research is solved by using Microsoft Excel Solver which is the solution obtained is optimal. This means that the menu chosen fulfilled the required nutrients. This research seeks to empower consumers to make healthier food choices and promote a more balanced diet and healthier lifestyle.

**Keywords:** *diet problem, linear programming, nutritional food, fast food, healthy diet*

### **INTRODUCTION**

Linear programming is a method used to maximize or minimize the objective function subject to a system of linear constraints. A linear programming problem must consist of decision variables, objective functions, linear constraints, and non-negative restrictions. The decision variables decide the output of the linear programming problem and represent the final solution. The objective function is the linear function that needs to be optimized to get the solution. The constraints are the restrictions imposed on the decision variables to limit their value. The decision variables must always have a non-negative value which is given by the non-negative restrictions. In this research, we propose a mathematical modelling for the diet problem by using the menus from the Burger King in Malaysia. The mathematical modelling is solved by using Microsoft Excel Solver which is a computer software. We use the Microsoft Excel Solver because it is easy to download and install on any Windows platform. In this research, we have six constraints and 27 variables.

Anith et al. (2021) investigated a diet problem involving menus in KFC using linear programming. This research was conducted to study whether the fast food that most people eat satisfies the nutritional requirements. The results obtained showed that all the daily requirements of a man are fulfilled however it does not satisfy the daily requirements of a woman. Muhammad and Nurul (2021) conducted this research to

minimize the amount of vitamin A consumed by the body due to the harm that it may bring such as bone-related diseases. This research was solved by using two methods; the graphical method and the Excel solver. Both methods give the same results, but the Excel solver gives a more precise value than the graphical method due to the value generated from it being in decimal values.

## METHODOLOGY

### Linear Programming

In this section we propose the mathematical modelling of the diet problem for Burger King’s menus in Malaysia for men and women. The mathematical modelling consists of objective function, constraints, and decision variables. In this research, the objective function is to maximize the requirement calorie intake and satisfying the required nutrients. The notations of the mathematical model for this diet problem are in Table 1.

**Table 1:** The notations in the diet problem of Burger King menus in Malaysia

Notation	Explanation
$x_i$	Sets menu for food in Burger Kings’ Malaysia
$c_i$	Calories for the set $x_i$
$p_i$	Carbohydrates for the set $x_i$
$q_i$	Protein for the set $x_i$
$r_i$	Fat for the set $x_i$
$s_i$	Salt for the set $x_i$
$t_i$	Sugar for the set $x_i$

The linear programming for the diet problem of Burger King menus in Malaysia is shown as follows:

$$\text{Max } c_1x_1 + c_2x_2 + c_3x_3 + \dots + c_{27}x_{27} \tag{1}$$

subject to

$$c_1x_1 + c_2x_2 + c_3x_3 + \dots + c_{27}x_{27} \leq 2500 / 2200 \tag{2}$$

$$p_1x_1 + p_2x_2 + p_3x_3 + \dots + p_{27}x_{27} \leq 375 \tag{3}$$

$$q_1x_1 + q_2x_2 + q_3x_3 + \dots + q_{27}x_{27} \leq 63 \tag{4}$$

$$r_1x_1 + r_2x_2 + r_3x_3 + \dots + r_{27}x_{27} \leq 80 \tag{5}$$

$$s_1x_1 + s_2x_2 + s_3x_3 + \dots + s_{27}x_{27} \leq 2300 \tag{6}$$

$$t_1x_1 + t_2x_2 + t_3x_3 + \dots + t_{27}x_{27} \leq 36 / 24 \tag{7}$$

$$x_1, x_2, x_3, \dots, x_{27} \geq 0 \tag{8}$$

The objective function (1) aims to get the maximum calorie intake by a person for a day. The equation (2) restricts the calorie intake for men is 2500 Kcal and women is 2200 Kcal. Equation (3) restricts the carbohydrate needed by a person for a day is 375

grams. Equation (4) is to make sure that protein taken by a person per day is at most 63 grams. Equation (5) guarantees that the fat intake by a person per day is 80 grams. Equation (6) restricts the intake of salt is at most 2300 mg for a person per day. Equation (7) is to make sure the sugar intake per day for men is not exceeds 36 grams and for women 24 grams. Equation (8) is to make sure that the variable is an integer number. The recommended daily nutrients for a diet of 2500 Kcal per day for men and 2200 Kcal per day for women from the Recommended Nutrient Intakes for Malaysia (2017). We solved the mathematical modelling by using the Microsoft Excel Solver. The results and discussion are discussed in the next section.

## RESULTS AND DISCUSSION

As we conduct this research, we constructed a mathematical model to solve the diet problem by using the Burger King’s menu in Malaysia. The main objective of this research is to maximize the number of calories that a person can consume while also satisfying all the nutritional requirements required by the body, for men and women. We solved the linear programming problem by using the Excel Solver. The results obtained from this research for men and women are not the same since the requirement of calories for men and women are different. The results obtained for the set menu consumed by men is 1940 Kcal while the set menu consumed by women is 1920 Kcal. The recommended food menu for men and women is represented in the Table 2.

**Table 2:** Number of recommended sets that need to be taken for men and women

<b>Men</b>		<b>Women</b>	
<b>Set menu</b>	<b>The number of sets that need to be taken</b>	<b>Set menu</b>	<b>The number of sets that need to be taken</b>
French fries	5	French fries	6
Apple pie	1		

## CONCLUSION

The linear programming problem can be used to solve various problems in our lives. The optimal solution for this problem can be obtained by using the Microsoft Excel Solver. While we solve this diet problem, it does not only help to balance our diet and ensure a healthy lifestyle, it could also help us to consume the proper amount of calories and nutritional requirements needed by the body. For the future research we want to solve the diet problem for the menus from the other fast-food chains.

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## REFERENCES

N. A. S. A. Latiff, F. N. K. Arifin, N. F. Mohamed. (2021). A Diet Problem for KFC’s Menu by Using Linear Programming, Proceeding Insan Junior Researcher Conference, 127 – 129.

M. N. Ruslan, N. F. Mohamed. (2020). The Diet Problem on Minimizing Vitamin A: Linear Programming Problem, Malaysian Journal of Science, Health & Technology, Volume 7, 48 – 52.