CONFERENCE PROCEEDING

A Diet Problem for KFC's Menu by Using Linear Programming

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ABSTRACT

The diet problem has been investigated since decades ago by the researchers since it is very important to our life and health. Nowadays, people often buying fast food without being aware that the foods might not satisfy the nutrients requirements by the body. For example, KFC is one of the people's favorite fast-food restaurants and most of the customers are not aware of the balanced diet in their food. In this research, a diet problem for different parts of fried chicken in KFC by using linear programming is being investigated. A mathematical modelling of the diet problem will be constructed in this research. After that, we will solve the mathematical modelling by using a computer-based method which is the Microsoft Excel Solver.

Keywords: *linear programming, integer programming, diet decision*

INTRODUCTION

Linear programming is a technique for the optimization of a linear objective function, subject to linear equality and linear inequality constraints. Linear Programming was first introduced by Leonid Kantorovich in 1939. In 1947, Dantzig published the simplex method and John von Neuman developed the theory of duality (Dantzig, 1947). Linear programming is useful for problems that require an optimization of resources. It could be applied in manufacturing (to calculate how to assign labor and machinery to minimize cost of operations), in high-level business operations (to decide which products to sell and in what quantity in order to maximize profit) and in logistics (to decide how to apply resources to get a job done in the minimum amount of time).

Patil and Kasturi (2016) demonstrates the use of linear integer programming for a human diet decision problem undertaken by dietician in health care. Specifically, they investigate the problem of deciding the diet of human of age 40-45 years old which is more intricate taking in consideration expenditure constraint. It details the constraint of problem, specifies the objective, structure mathematical model and applies operation research tool integer programming to decide patient diet with minimum expenditure. The paper illustrates the effectiveness of linear integer programming in diet decision. The finding of paper enables the optimum diet expenditure per day considering readily available food. The paper helped to understand the major human body requirement at the age of 40-45 years and application of linear programming to get optimal diet.

Manmohan *et al*. (2019) aim to use linear programming to allocate minimum cost and maximum fulfill the daily requirements of vitamin, minerals and nutritional requirements to fulfill the daily requirements by the human body at age of 25-50 years.

Their objective is to minimize the whole price of vitamins and minerals for food and unit price particularly.

Cristina-Elena and Ciprian-lonel (2010) solved a diet problem which has the goal to find an optimal combination of proposed foods on the condition that the daily nutritional requirements of a person are satisfied. The mathematical model of the problem is formulated as a linear program where the objective function is the total amount of calories for the proposed menu, on the condition that the constraints regarding the amounts of protein, vitamins, minerals, fats, dietary fibre consumed throughout an entire day are satisfied.

METHODOLOGY

An integer linear programming problem is defined as the optimization of a linear function subject to a set of linear constraints over integer variables. In this research, we describe the model formulation of the diet problem for KFC's sets menu in Malaysia. The objective function is to maximize the intake of calories for the given diet while restricting the minimum requirement of calories intake. While the nutritional requirements by a person are satisfied, the menu that will be chosen is determined by solving the mathematical modelling. The formulation of the diet problem of KFC's sets menu in Malaysia is demonstrated. The notations used in the model are summarised in Table 1.

Table 1. The notations in the diet problem of KFC's sets menu in Malaysia

Notation	Explanation
x_i	KFC's sets menu in Malaysia
c_i	Calories for the set menu x_i
t_1	Calories intake for a person for the set menu x_i
t_2	Carbohydrates for the set menu x_i
t_3	Protein for the set menu x_i
t_4	Fats for the set menu x_i
t_5	Salt for the set menu x_i
t_6	Sugar for the set menu x_i

The integer linear programming for the diet problem of KFC's sets menu in Malaysia is shown as follows:

$$\text{Min} \quad c_1x_1 + c_2x_2 + \ldots + c_ix_j \tag{1}$$

$$\text{subject to} \quad t_4x_1 + t_4x_2 + \ldots + t_4x_j \leq 2500 \tag{2}$$

$$t_3x_1 + t_3x_2 + \ldots + t_3x_j \leq 375 \tag{3}$$

$$t_3x_1 + t_3x_2 + \ldots + t_3x_j \leq 63 \tag{4}$$

$$t_4x_1 + t_4x_2 + \ldots + t_4x_j \leq 80 \tag{5}$$

$$t_5x_1 + t_5x_2 + \ldots + t_5x_j \leq 6 \tag{6}$$

$$t_6x_1 + t_6x_2 + \ldots + t_6x_j \leq 50 \tag{7}$$

$$x_1 + x_2 + \ldots + x_j \leq 0 \tag{8}$$

The aim of the objective function (1) is to get the maximum calories intake by a person. Equation (2) restricts that calories intake by a man is 2500 kcal while equation (3) restricts that carbohydrates needed to be taken by a person is 375 grams at most. Equation (4) makes sure that a person's protein intake is 63 grams and equation (5) ensure that the fats taken by a person are limited to at most 80 grams. Equation (6) restricts the intake of salt for a person is at most 6 grams while equation (7) makes sure that a person's sugar intake is at most as 50 grams only.

RESULTS AND DISCUSSION

By using the menu from KFC, we solve the mathematical problem of linear programming by using the computer-based method using the solver tool from Microsoft Excel. The proposed research aims to get an optimal menu of KFC that satisfied all the daily requirements. From the results obtained, the menu chosen has all the daily requirements needed by a man.

CONCLUSION

As the conclusion, the linear programming for the diet problem of KFC's menu has been solved by Microsoft Excel Solver. From the results, it showed that all the daily requirements by a man are fulfilled. In the future, the diet problem can be explored and solved by using exact methods that can give an optimal solutions.

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