1.5

OPTIMIZATION IN NUTRIONAL VALUE FROM FOOD

INTRODUCTION

The food that we consume today is based on a paradigm designed for a much more physically active lifestyle than ours. We have inherited our food habits for generations and therefore while the advent of technology has led to a decrease in energy utilization, our rate of energy consumption remains the same. As a result, cases of obesity has increased leading to a large number of health related problems. In order to mitigate these problems, there is a need for a solution that allows us to maximize the nutritional gain from our food while enabling us to maintain our weight below a threshold. This is an active area of research for nutritional scientists with WHO already devoting resources towards it. An effective solution would go a long way towards making the planet healthier.

ROLE OF OPTIMIZATION IN THE SOLUTION

Optimization would play a pivotal role in achieving a sustainable and efficient solution to this problem. The problem could essentially boil down to a knapsack problem where the nutritional value of each food item could be the "value" and its contribution to an increase in weight be the "weight" while the threshold for weight be the "constraints" in the traditional setting of the knapsack problem. The **knapsack problem** or **rucksack problem** is a problem in combinatorial optimization: Given a set of items, each with a weight and a value, determine the number of each item to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible. This would be an example of a bounded knapsack problem. It is a NP-hard problem.

FORMAL PROBLEM STATEMENT

Let the nutritional value of the i'th food item be V_i.

Let quantity of i'th food item taken be X_i and maximum possible quantity of each be C_i.

Let Contribution of i'th food item in increase of weight be W_i.

Let threshold for increase in weight be W.

Then the objective function would be:

Maximize $\sum X_i V_i$

Subject to $\sum W_i X_i \leq W$ and $0 \leq X_i \leq C_i$.

Effective Solutions

Several algorithms are available to solve knapsack problems, based on dynamic programming approach, branch and bound approach or hybridization of both approaches. There are also approximation algorithms present to compute an approximate solution.