Math 170 Term Project: Mathematical Methods for Optimization

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April 19, 2020

George Stigler's Diet Problem

Table A gives us values of calories, nutrients, proteins, etc for 77 different types of foods. Our diet would solve for the amount of each food component in the diet, we will name this values from $x_1, ..., x_{77}$ for food element 1 to 77 correspondingly. The number of constraints are given by table 1 that has 9 constraints or minimum allowance of different nutrients that have to be present in a optimum diet.

In our main program we import table A from an excel file, we transpose the matrix so that we have a matrix with 9 rows and 77 columns.

So far the program that we have has the following form:

$$min : \sum_{i=1}^{77} x_i$$

subject to.

$$\sum_{i=1}^{77} a_{ji} x_i \geq b_j$$

The first step in solving the problem will imply taking the problem into a canonical form, for which we need to add 9 slack variables.

$$\textstyle\sum_{i=1}^{77} a_{ji} x_i - z_j = b_j \qquad\qquad for \quad j = 1, ..., 9$$

Solution

We run the following script:

```
b = [3 70 .8 12 5 1.8 2.7 18 75]'; %allowance

A = [food_matrix' -eye(9)];

c = [ones(1,77) zeros(1,9)]';

[data_DP, info_DP] = LP3035474642(A, b, c);
```

After running the program we get to the solution $x_1 = 0.029519; x_{30} = 0.0018926, x_{46} = 0.011214, x_{52} = 0.0050077, x_{69} = 0.061029$. With all other components with index < 77 being zero. The value for the dual y is:

$$\begin{matrix} 0.0087 \\ 0 \\ 0.0317 \\ -1.7e-18 \\ 0.004 \\ 0 \\ 0.163 \\ 0 \\ 0.000144 \end{matrix}$$

. We present the same results in the following table:

Food	Dollar amounts
Wheat Flour	0.029519
Liver (beef)	0.0018926
Cabbage	0.011214
Spinach	0.0050077
Navy Beans, dried.	0.061029
Primal Solution (Optimal daily cost):	**0.10866**
Yearly optimal:	39.662