MATH3202/7232 Operations Research & Mathematical Planning 2020

Tutorial 1 – The Cost of Subsistence

George Stigler's 1945 paper "The Cost of Subsistence" (*Journal of Farm Economics*, **27**, 303-314) presents one of the earliest applications of linear programming, that of finding minimum-cost diets:

> "Elaborate investigations have been made of the adequacy of diets at various income levels, and a considerable number of 'low-cost,' 'moderate,' and 'expensive' diets have been recommended to consumers. Yet, so far as I know, no one has determined the minimum cost of obtaining the amounts of calories, protein, minerals, and vitamins which these studies accept as adequate or optimum."

A Python stub is available on Blackboard which contains some nutritional and cost data for a sample of foods. Use this data to determine an optimal diet using these foods.

Sets F foods

N nutrients.

Data c_f cost of food $f \in F$ ($/100g)

a_{fn} nutrient $n \in N$ per 100g of food $f \in F$

rdi_n required nutrient $n \in N$

M_n maximum nutrient $n \in N$ (if applicable)

Variables x_f amount to eat of food $f \in F$.

Objective Min $\sum_{f \in F} c_f x_f$

Constraints

$$\sum_{f \in F} a_{fn} x_f \geq rdi_n \quad \forall n \in N$$

$$\sum_{f \in F} a_{fn} x_f \leq M_n \quad \forall n \in N \text{ s.t. } M_n > 0$$

$$x_f \geq 0 \quad \forall f \in F.$$