***LP model***

The goal of an LP-based model is to minimize or maximize an objective function while following a set of constraints represented as linear relations. In our case, the objective function is the difference between each individual’s diet and the mean diet. We follow a similar formulation as the one described by Darmon, et al.[1] We define the objective function, f, as:

|  |  |
| --- | --- |
| $$f=\left|(x\_{1}-m\_{1})\right|/m\_{1}+\left|(x\_{2}-m\_{2})\right|/m\_{2}+\cdots +\left|(x\_{9}-m\_{9})\right|/m\_{9}$$ | (1) |

where $m\_{1}$ to $m\_{9}$ are the mean diet elements representing mean caloric intakes for each of the main food categories; $x\_{1}$ to $x\_{9}$ are the corresponding caloric intakes of the population under study. The absolute distance (|x|) is normalized by dividing by the mean values. The following constraints were defined for the model:

|  |  |
| --- | --- |
| $$\sum\_{i=1}^{9}x\_{i}=100$$ | (2) |
| $$\sum\_{i=1}^{9}(x\_{i}/100)\*EI\*Price\_{i}\leq budget$$ | (3) |
| $$15^{th} percentile (x\_{i})< x\_{i}<85^{th} percentile (x\_{i})$$ | (4) |

Here, the first constraint ensures that the set of $x\_{i}$s represent percentages of energy intake, EI, contributed by each food category. The second constraint, $Price\_{i}$, refers to the price (price per calorie) of the ith food category. This constraint is needed to keep the total cost of the diet to be less than the food-budget. As for the proposed ABM, we avoid generation of unrealistic results by considering only $x\_{i}$s that are between the 15th and 85th percentiles of food consumption data.

**References:**

1. Darmon N, Ferguson EL, Briend A. A Cost Constraint Alone Has Adverse Effects on Food Selection and Nutrient Density: An Analysis of Human Diets by Linear Programming. J Nutr. 2002;132(12):3764-71.