Humanitarian Food Assistance Optimization

Problem Statement & Motivation:

Food insecurity has been rising at an alarming rate worldwide – from 2019 to present, the number of those facing this issue has rising from 135 million to 345 million. This food insecurity is not normally distributed across the world – Sub-Saharan Africa and South Asia have the highest rates, due to local food production constraints and large population sizes. These areas require increased access to food, which is available in excess in other areas of the world. However, this transportation problem is not simple to solve: while our needs are rising, our financial resources have been tightened, coming off of the COVID-19 pandemic and a possible economic recession. The ultimate goal of this project is to minimize experienced hunger in the most cost-efficient manner feasible, all while ensuring that appropriate nutrition is provided to those in need.

Methods:

1. **Data exploration:** use Python to conduct exploratory data analysis; understand the distribution of food excess and food shortages across all countries
2. **Data preprocessing**:
    a. **Data aggregation**: aggregate datasets from multiple sources into one Data Frame
    b. **Feature engineering**: transform the undernourished population size to nutrition shortage for each country; map each food item to main nutritional contents; perform any smoothing, outlier processing, normalization when necessary
3. **Data modeling**: build a model that minimizes total transportation costs for the entire network, subject to
    a. Demand constraint: nutrition level demand for each type of nutrients in each country
    b. Supply constraint: amount and categories of food excess for each country
    c. Transportation cost constraint: total transportation cost for the network should stay below a maximum limit

Data:

We have access to a dataset which outlines the production of certain food groups across the majority of countries across the globe. This dataset contains the geographic distribution of the

data (i.e., the latitude and longitude we will use for the countries) to be used in part for calculating transportation costs. Building on this first dataset, we have a count of undernourished persons per country, as well as a nutritional mapping for each food group contained in our dataset, which will be used in the context of our project to ensure that each recipient of humanitarian aid is well served relative to average nutritional needs.

Expected Results:

There is an understanding that target zero is infeasible at current food production and consumption levels. However, we expect to be able to find a solution of minimal costs which significantly reduces the experienced hunger on a global scale. Additionally, an extension of this project will be to experiment with the effects of reducing consumption in developed countries and observing the impact on costs and reduction in hunger—as motivated by the fact that a nonzero amount of food consumption ultimately results in food waste.

Roles & Responsibilities for the Team:

The tasks for this project are laid out below. We have assigned a lead member for each task; however, for each of these tasks we plan on working collaboratively, not as individual silos.

- EDA of food production dataset (Sri)
- Food production dataset preprocessing (Sri)
- Aggregation of undernourished population dataset with initial food production dataset (Sri)
- Nutritional needs research by Food groups (Reid)
- Clustering of food items into nutritional needs (Reid)
- Nutritional content research (Michelle)
- Weighing of food items by nutritional content (Michelle)
- Network Model formulation (on paper) (Reid)
- Network Model implementation (JULIA <3) (all members)