The "Where" and "When" of food distribution.

Feeding America is a network of organizations striving to provide food security for people with limited financial resources. The Food Bank of the Southern Tier (FBST) is one of these organizations, serving six counties and nearly 4,000 square miles in New York State.

In normal years, the Mobile Food Pantry (MFP) program is among the main activities of FBST. The goal is to make nutritious and healthy food more accessible to people in underserved communities. Even in areas where other agencies provide assistance, clients may not always have access to food because of limited transportation options or because those agencies are only open certain hours or days per week.

An MFP provides food directly to clients in pre-packed boxes or through a farmers market-style distribution. When an MFP truck arrives at a site, volunteers lay out the food on tables surrounding it. The clients can then "shop", choosing items that they need. Each truck can transport up to 15,000 pounds. Three MFP trucks are available, and FBST usually has enough food and volunteers to operate 2 of them on any given day. A typical mobile pantry visit lasts two hours and provides 200 to 250 families with nutritious food to help them make ends meet. The schedule of all MFP site visits is published months in advance, to help clients plan accordingly.

Unfortunately, the COVID-19 pandemic forced FBST to modify its services. The current version of the MFP program is very limited in scope & far less flexible: offering monthly visits to only 9 major sites, requiring all clients to register in advance for each pick-up, and using socially-distanced pick-up options. FBST plans to return to a pre-pandemic level of MFP services next year and will allow clients to simply show up when a truck visits without having to sign up in advance. Your team's goal is to help them optimize the schedule for 2021 using the statistical data from 2019. In that year, MFP has serviced 70 regular sites, with 722 visits across all of them. The map (with site locations & demand serviced at each of them) is included below.

We ask you to complete only three of the following 4 tasks: 1 + ***either*** 2 ***or*** 3 + 4.

1. Propose an **effective** & **fair** schedule for visiting all of these 70 regular sites in 2021. The frequency of visits should be informed by the total demand in surrounding communities.
   Effectiveness: how well do you serve all clients on average?
   Fairness: are some of them served much better than others?

2. Based on historical data, on particularly cold winter days, the number of clients attending an MFP visit can be much lower than usual. But when the weather improves, the demand often spikes for the next visit to any site nearby. This suggests that some of the clients (those who own cars or have better public transportation options) are willing to come to pick-up sites that are a little farther. Of course, this only works if the timing of MFP visits to those nearby sites is suitable.

You can try to incorporate this information in two very different ways:

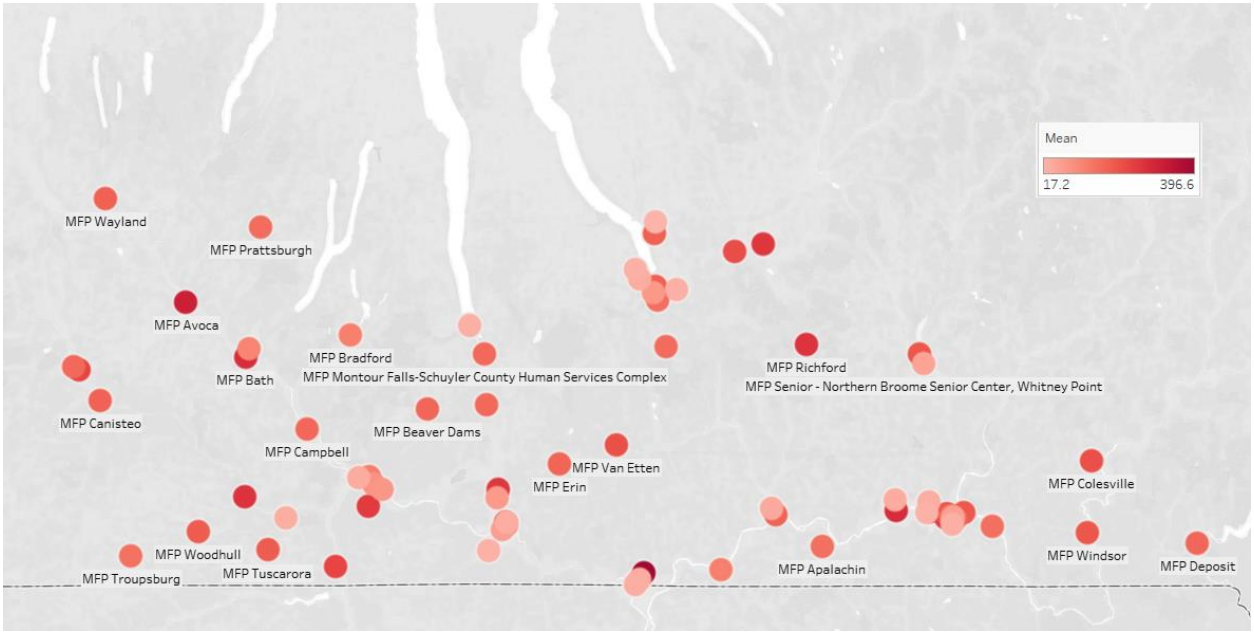
(a) Reduce the total number of serviced sites (and optimize their location), hoping that people will still drive or take a bus to them, or

(b) Keep the number & location of sites the same, but schedule the MFP visits in a way that makes such longer trips by clients feasible (even if less desirable).

Modify your previous scheduling approach to incorporate **one** of the above two option. Quantify the resulting improvements in performance.

3. To optimize the volunteers' efforts, the FBST is also considering a new option of sending the same truck to visit two different sites on some of the trips. Along with the challenge of selecting the sites and the date, this would also make it necessary to decide on the amount of food to dispense at the first site (since without pre-registration the demand at the next site is not known for sure). Suggest an algorithm to address this, characterizing both the effectiveness & fairness of the resulting distribution.

4. Along with your technical manuscript, please submit a 1-page executive summary, describing the key advantages and potential drawbacks of your recommendations.



Location of 70 MFP distribution sites across the six counties of New York State regularly serviced by FBST in 2019.
(The above omits 12 more sites, which were serviced only occasionally – less than 5 times each in 2019.)
The color of disks indicates the average demand (the number of clients serviced per visit) for each of the sites.
Most of these sites are unfortunately not serviced in 2020.
Graphical information summary by Dr. F. Alkaabneh. A spreadsheet version of this dataset is also available here.

Also relevant: https://www.foodbankst.org/wp-content/uploads/2019-MFP-Facts.pdf