Welcome to Spencer, West Virginia!

Methodology

- Assumptions
  - Shipping is a linear function of weight and distance

$$cost_{ship} = constant * weight * distance$$

  - There are two warehouses
  - Either warehouse is stocked and capable of fulfilling an order

- Shipping costs for all sites becomes

$$netcost_{ship} = constant * \sum_{site} weight_{site} * closestdistance_{site}$$

  - Here the closest distance is the distance from the closest warehouse to the site we are shipping to

- We used a brute force approach
  - The calculation above was performed thousands of times, each time using a city we've shipped to as a tentative location of the secondary warehouse
  - We then sorted the results to see which city had the lowest $netcost_{ship}$ when operating as a secondary warehouse

Results

Top 3 Cities	
City	Weight * Distance (kg*km)
Spencer, WV	1.023235e+10
Charleston, WV	1.024362e+10
Clarksburg, WV	1.024369e+10

Bottom 3 Cities	
City	Weight * Distance (kg*km)
Lancaster, TX	1.539499e+10
Red Oak, TX	1.542455e+10
Waxahachie, TX	1.541763e+10

- Building a second facility near Dallas offers little to no optimization!
- It’s fun to say “Spencer, WV” but the state of West Virginia offers a lot of contenders. Charleston is more metropolitan and closer to the West Virginia International Yeager Airport
- A second facility in Charleston would theoretically provide savings in shipping costs of roughly **34%**

34%!

… there's a little more meat on that bone

- Getting this right has the potential to save us a lot of money:
    - Looking at our sites on a map we could have easily guessed California as a candidate, but we anticipate sites in California to have >**10%** more expensive shipping costs based on this analysis

- There were data points that were dropped in our analysis because our code could not find a latitude and longitude value for the city
    - We assume these did not include major outliers for weight shipped, but we should make sure
    - We assume that the missing data points are evenly distributed geographically, and that there are no major regions missing, but we should make sure

- We used a brute force approach but the problem looks like a Linear Optimization problem
    - These are a well-documented type of math problem that we should look into more closely.
    - Solving this problem with linear optimization, *may* point us towards a different solution
    - An understanding of Linear Optimization problems will be needed by our team regardless after we establish the second warehouse, as they are *the* solution for distributing shipping requests between warehouses