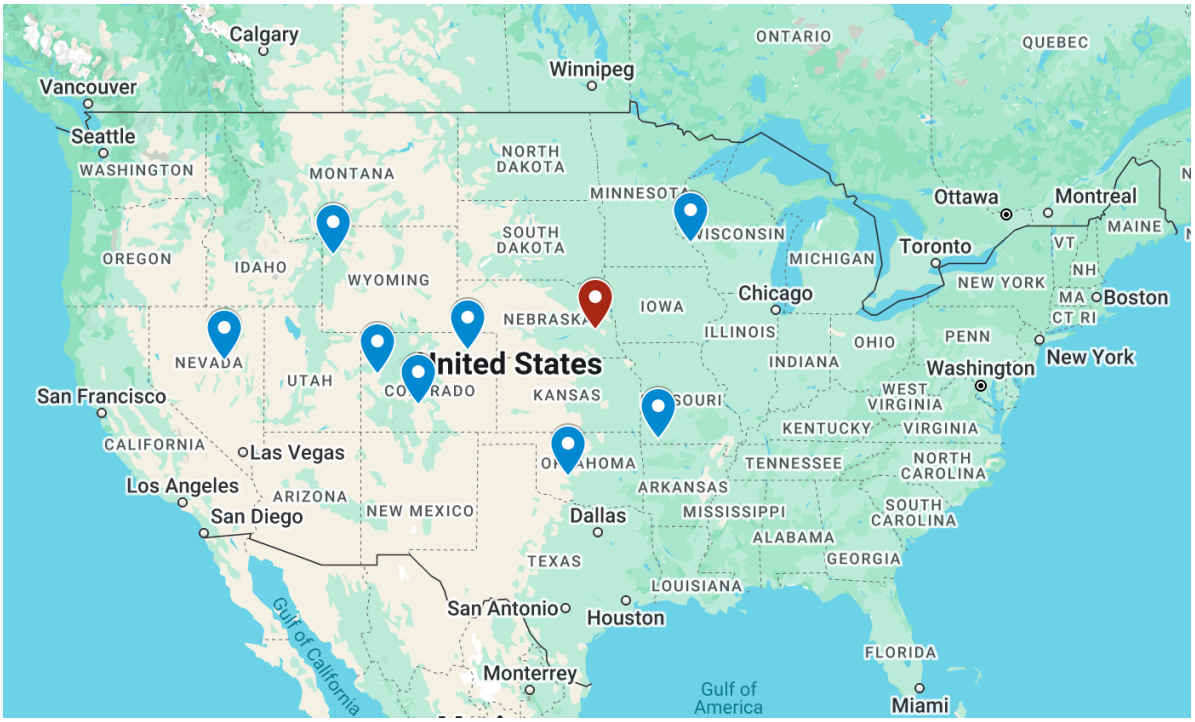
Module 12 – Location Graph

Exploratory Data Analysis

In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:

- *Make a visual graph of your data on a map (coordinates should be within US borders)*
    - https://mymaps.google.com/
    - Find a map with latitude/longitude and place them approximately
    - Any alternative that gives the same effect



- The **BLUE** markers on the map are the locations of the store and the **RED** marker is the location of the Current DC.
- Use your available data to determine a good starting coordinate for the DC
    - Should you use the average of the ranges of lat longs of the stores?
        - This is the option I went for. The model bellow represents this.
    - Should you use the coordinates of the store furthest away from the current DC?
    - Can you think of something better to use?
    - Whatever you use, please record the optimal function with your starting coordinate to compare to your optimized model

	Store Location		Current DC			New DC			Model Decision	
Stores	Latitude	Longitude	Latitude	Longitude	Current DC Distance	Latitude	Longitude	New DC Distance	Use New?	Distance
Candy Cane Canyon	35.2	-98.45	41.1	-97.02	6.07	39.76	-103.64	6.91	TRUE	6.07
Chocolate Chip Cliffs	38.15	-106.21	41.1	-97.02	9.65	39.76	-103.64	3.03	FALSE	3.03
Fizzwhiz Fjord	36.72	-93.75	41.1	-97.02	5.47	39.76	-103.64	10.35	TRUE	5.47
Ginger Snap Garden	39.92	-116.16	41.1	-97.02	19.18	39.76	-103.64	12.52	FALSE	12.52
Mochi Metropolis	43.94	-110.57	41.1	-97.02	13.84	39.76	-103.64	8.09	FALSE	8.09
Pineapple Pop Paradise	39.4	-108.28	41.1	-97.02	11.39	39.76	-103.64	4.65	FALSE	4.65
Starburst Starlit Skies	44.39	-92.08	41.1	-97.02	5.94	39.76	-103.64	12.45	TRUE	5.94
Taffy Tundra	40.33	-103.62	41.1	-97.02	6.64	39.76	-103.64	0.57	FALSE	0.57
	Objective:	46.35			New DC:	39.76	-103.64			

Model Formulation

Try to write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints. Hint: Linking constraints aren't needed since we are using Nonlinear GRG but refer to the associated PowerPoint in your data if you need help.

Model Optimized for Distance Reduction from DC to Store

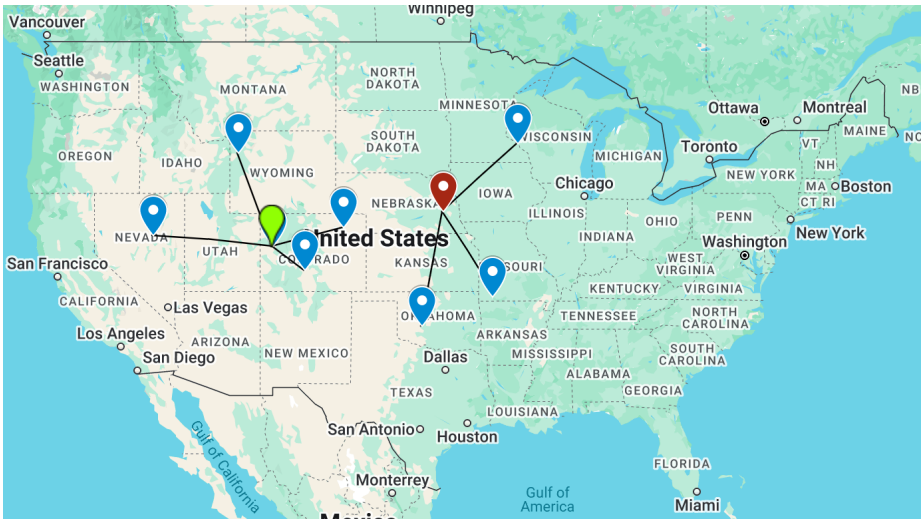
Implement your formulation into Excel and be sure to make it neat. This section should include:

- *A screenshot of your optimized final model (formatted nicely, of course)*

	Store Location		Current DC			New DC			Model Decision	
Stores	Latitude	Longitude	Latitude	Longitude	Current DC Distance	Latitude	Longitude	New DC Distance	Use New?	Distance
Candy Cane Canyon	35.2	-98.45	41.1	-97.02	6.07	39.40	-108.280	10.69	TRUE	6.07
Chocolate Chip Cliffs	38.15	-106.21	41.1	-97.02	9.65	39.40	-108.280	2.42	FALSE	2.42
Fizzwhiz Fjord	36.72	-93.75	41.1	-97.02	5.47	39.40	-108.280	14.78	TRUE	5.47
Ginger Snap Garden	39.92	-116.16	41.1	-97.02	19.18	39.40	-108.280	7.90	FALSE	7.90
Mochi Metropolis	43.94	-110.57	41.1	-97.02	13.84	39.40	-108.280	5.08	FALSE	5.08
Pineapple Pop Paradise	39.4	-108.28	41.1	-97.02	11.39	39.40	-108.280	0.00	FALSE	0.00
Starburst Starlit Skies	44.39	-92.08	41.1	-97.02	5.94	39.40	-108.280	16.95	TRUE	5.94
Taffy Tundra	40.33	-103.62	41.1	-97.02	6.64	39.40	-108.280	4.75	FALSE	4.75
	Objective:	37.62			New DC:	39.40	-108.28			

- *A text explanation of what your model is recommending*
    - *My model is recommending that we keep the Current DC for 3 of our stores (Candy Cane Canyon, Fizzwhiz Fjord and Starburst Starlit Skies) and have the rest of the stores (Chocolate Chip Cliffs, Ginger Snap Garden, Mochi Metropolis, Pineapple Pop Paradise and Taffy Tundra) use the New DC.*

- *Update your graph from the EDA section by adding in your new DC and add indicators of which Stores are serviced by which DC*



- The **BLUE** markers on the map are the locations of the store, the **RED** marker is the location of the Current DC and the **GREEN** marker is the New DC. The lines in the map show what Stores are using what DC.

Model with Stipulation

Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution.

You should notice that while distance is minimized between each store and each DC, there is a discrepancy between how much demand is serviced between each DC (i.e. one DC may service a lot more demand than others). Please:

1. *Choose one:*
    a. *Implement a change that picks a location for the new DC to distance **AND** load. You can do this by multiplying distance by demand if a store is serviced by a particular DC.*
    b. *Instead of just summing the distance, also add the difference between demand serviced between each DC (i.e. if the old DC serves stores with 8000 total demand and the new DC does 3000 then the difference would be 5000). Be sure to not remove the sum of distance too, it should be both. You may want to add weights and such but not necessary*

2. *Provide a text explanation on what your model is recommending now with this change.*

	Store Location		Current DC			New DC			Model Decision		Demand		
Stores	Latitude	Longitude	Latitude	Longitude	Current DC Distance	Latitude	Longitude	New DC Distance	Use New?	Distance	Last Years	This Years	Difference
Candy Cane Canyon	35.2	-98.45	41.1	-97.02	6.07	40.09	-115.859	18.08	TRUE	6.07	1481.91	1392.995	88.915
Chocolate Chip Cliffs	38.15	-106.21	41.1	-97.02	9.65	40.09	-115.859	9.84	TRUE	9.65	1434.04	1347.998	86.042
Fizzwhiz Fjord	36.72	-93.75	41.1	-97.02	5.47	40.09	-115.859	22.36	TRUE	5.47	1536.96	1414.003	122.957
Ginger Snap Garden	39.92	-116.16	41.1	-97.02	19.18	40.09	-115.859	0.35	FALSE	0.35	1748.65	1941.002	-192.352
Mochi Metropolis	43.94	-110.57	41.1	-97.02	13.84	40.09	-115.859	6.54	FALSE	6.54	2210.11	1966.998	243.112
Pineapple Pop Paradise	39.4	-108.28	41.1	-97.02	11.39	40.09	-115.859	7.61	FALSE	7.61	2025.84	1802.998	222.842
Starburst Starlit Skies	44.39	-92.08	41.1	-97.02	5.94	40.09	-115.859	24.16	TRUE	5.94	1524.44	1371.996	152.444
Taffy Tundra	40.33	-103.62	41.1	-97.02	6.64	40.09	-115.859	12.24	TRUE	6.64	1326.79	1486.005	-159.215

	Objective:	1350.27			New DC:	40.09	-115.86							

TRUE	7012.997
FALSE	5710.997
Absolute	1302.000

- *The model is now recommending that we keep the Current DC for 5 of our stores (Candy Cane Canyon, Chocolate Chip Cliffs, Fizzwhiz Fjord, Starburst Starlit Skies, and Taffy Tundra) and have the rest of the stores (Ginger Snap Garden, Mochi Metropolis, and Pineapple Pop Paradise) use the New DC. As well as our model now aims to minimize the total delivery burden, factoring in both distance and store demand. It assigns higher-demand stores to the DC (whether new or current) that results in a more efficient weighted outcome. The objective value has shifted to 1,350.27, which reflects the total weighted distance (not just geographic distance).*

3. *Explain the changes to your Solver/Model.*
   a. I added the data for last year's demand into the model, as well as this year's demand then calculated the difference. After that I calculated the sum of the TRUE and FALSE demand and then got the absolute difference. Later I used that absolute difference by adding it to my objective function to get a value that considers the distance and demand serviced between each DC. After making all those changes I ran the solver and got the answer in the model above.