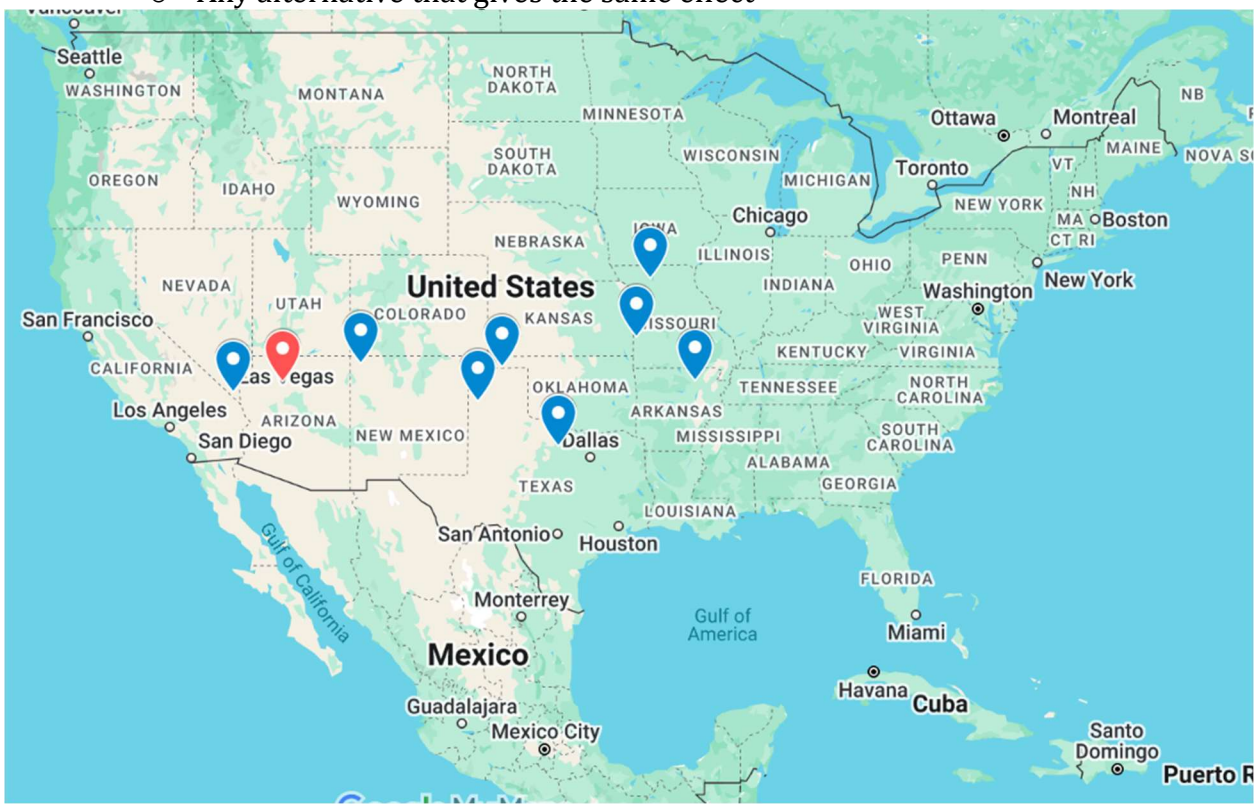
Module 12 – Location Graph

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



- 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?
    - 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

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.

Min Distance:

Bubblegum Bay: $\sqrt{(X-35.51X1)\text{^}2}+\sqrt{(Y+115.12Y1)\text{^}2}$

Buttercream Beach: $\sqrt{(X-36.03X2)\text{^}2}+\sqrt{(Y+91.62Y2)\text{^}2}$

Caramel Cascades: $\sqrt{(X-36.73X3)\text{^}2}+\sqrt{(Y+108.64Y3)\text{^}2}$

Caramel Corn Caverns: $\sqrt{(X-40.12X4)\text{^}2}+\sqrt{(Y+93.86Y4)\text{^}2}$

Cherry Jubilee Junction: $\sqrt{(X-35.2X5)\text{^}2}+\sqrt{(Y+102.68Y5)\text{^}2}$

Cocoa Bean Crater: $\sqrt{(X-37.83X6)\text{^}2}+\sqrt{(Y+94.57Y6)\text{^}2}$

Fudge Falls: $\sqrt{(X-36.62X7)\text{^}2}+\sqrt{(Y+101.41Y7)\text{^}2}$

Ginger Snap Garden: $\sqrt{(X-33.27X8)\text{^}2}+\sqrt{(Y+98.52Y8)\text{^}2}$

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:

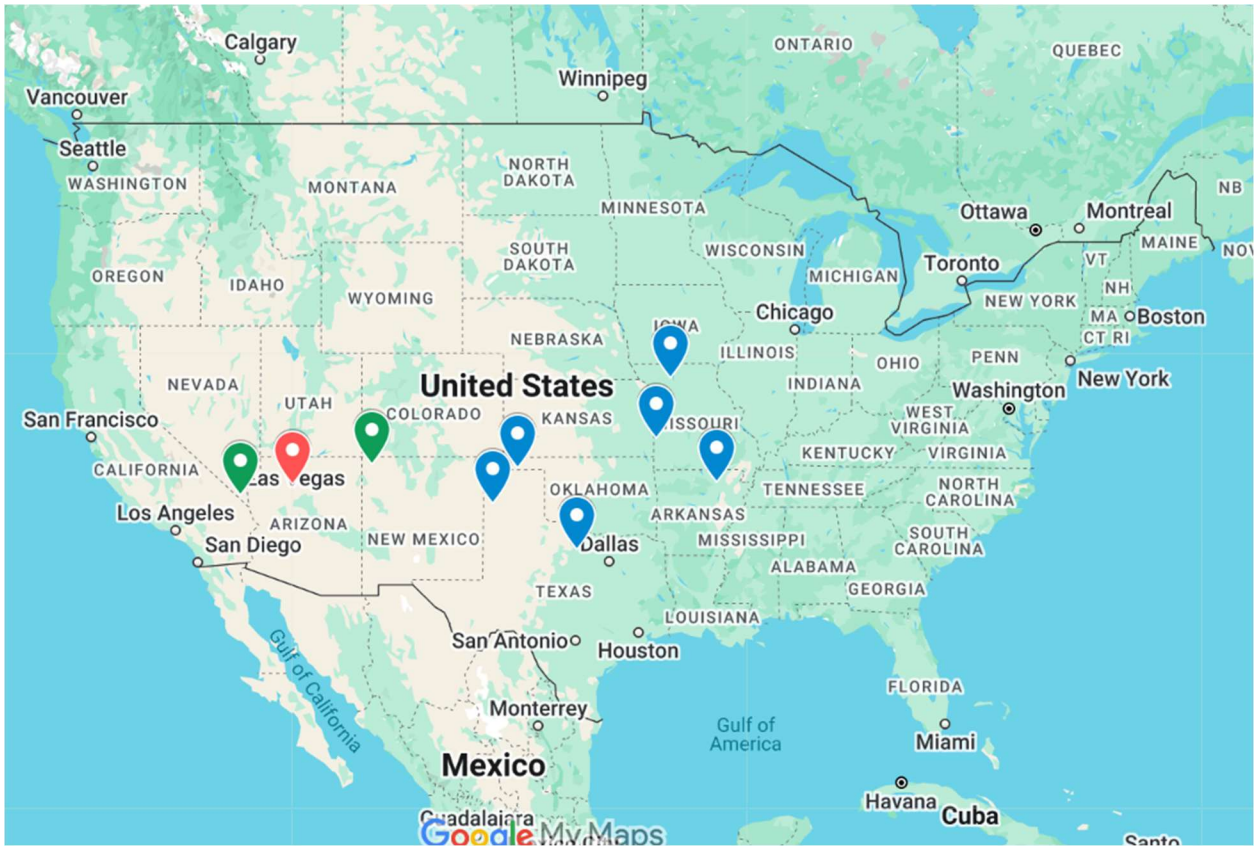
- *A screenshot of your optimized final model (formatted nicely, of course)*

						Lat	Long			
	Objective:	39.05			New DC:	35.98955	-112.573			
	Store Location		Current DC			New DC			Model Decision	
Stores	Lat	Long	Lat	Long	Current DC Dist	Lat	Long	New DC Dist	Use New?	Dist
Bubblegum Bay	35.51	-115.12	32.86	-98.06	17.26	35.99	-112.57	2.59	TRUE	2.59
Buttercream Beach	36.03	-91.62	32.86	-98.06	7.18	35.99	-112.57	20.95	FALSE	7.18
Caramel Cascades	36.73	-108.64	32.86	-98.06	11.27	35.99	-112.57	4.00	TRUE	4.00
Caramel Corn Caverns	40.12	-93.86	32.86	-98.06	8.39	35.99	-112.57	19.16	FALSE	8.39
Cherry Jubilee Junction	35.20	-102.68	32.86	-98.06	5.18	35.99	-112.57	9.92	FALSE	5.18
Cocoa Bean Crater	37.82	-94.57	32.86	-98.06	6.06	35.99	-112.57	18.10	FALSE	6.06
Fudge Falls	36.62	-101.41	32.86	-98.06	5.04	35.99	-112.57	11.18	FALSE	5.04
Ginger Snap Garden	33.27	-98.52	32.86	-98.06	0.62	35.99	-112.57	14.31	FALSE	0.62

- *A text explanation of what your model is recommending*

  My model is recommending that my new DC would be close to most of the stores. It would make the distance between all of them quite low so that each of the stores are relatively close to the new DW. The current distance is all low. Basically, only Bubblegum Bay and Caramel Cascade would use the new DC. The rest of them would use the old DC because the distance would be more if they used the new one.

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



Red = New DC
Green = Served by new 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.*

								Lat	Long			
	Objective:	58178.11					New DC:	36.73	-108.64003			
	Store Location		Current DC				New DC			Model Decision		
Stores	Lat	Long	Lat	Long	Current DC Dist	Next Year Demand	Lat	Long	New DC Dist	Use New?	Dist	New Demand
Bubblegum Bay	35.51	-115.12	32.86	-98.06	21097.32	1222.00	36.73	-108.64	8057.64	TRUE	8057.64	9846429.42
Buttercream Beach	36.03	-91.62	32.86	-98.06	9266.66	1291.00	36.73	-108.64	21991.35	FALSE	9266.66	11963209.80
Caramel Cascades	36.73	-108.64	32.86	-98.06	16650.53	1478.00	36.73	-108.64	0.04	TRUE	0.04	61.31
Caramel Corn Caverns	40.12	-93.86	32.86	-98.06	13067.46	1558.00	36.73	-108.64	23625.18	FALSE	13067.46	20359072.48
Cherry Jubilee Junction	35.20	-102.68	32.86	-98.06	8270.54	1597.00	36.73	-108.64	9826.77	FALSE	8270.54	13208035.88
Cocoa Bean Crater	37.82	-94.57	32.86	-98.06	10461.77	1725.00	36.73	-108.64	24343.52	FALSE	10461.77	18046546.20
Fudge Falls	36.62	-101.41	32.86	-98.06	8037.27	1596.00	36.73	-108.64	11540.47	FALSE	8037.27	12827491.77
Ginger Snap Garden	33.27	-98.52	32.86	-98.06	1016.73	1650.00	36.73	-108.64	17647.04	FALSE	1016.73	1677602.36

    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.*

   Now my model is accounting for the amount of demand that we will have in the new year. This means that if the new DC is used, it will need more from other places. It is moving the distribution center to more accurately serve the rest of the store locations.

3. *Explain the changes to your Solver/Model.*

- List would be multiplying the current distance by demand if they do not use the new DC. If they do use the new DC, we will multiply the new DC distance by next year's demand. This is because we are forecasting the new DCs demand to be net year. If our stores are using the current DC next year, we just multiply by the current distance. If they are using the new DC, we need to forecast that amount, that is why we multiply by the new DCs demand.