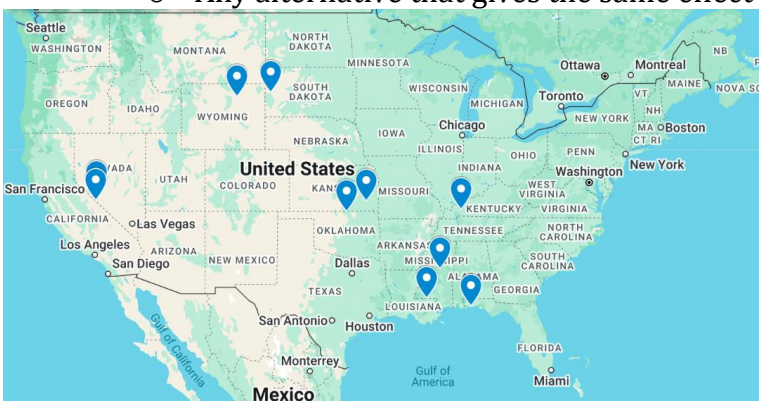
Module 12 – Location Graph

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 it 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? Yes, average was used to determine starting point
    - Should you use the coordinates of the store furthest away from the current DC? No
    - Can you think of something better to use? No, I think this is the best I don't know other alternatives, I am using best judgement here
    - 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:

$$\sqrt{(37.02-x_1)^2+(-87.79-y_1)^2}+\sqrt{(44.55-x_1)^2+(-103.68-y_1)^2}+$$
$$\sqrt{(37.77-x_1)^2+(-188.31-y_1)^2}+\sqrt{(30.5-x_1)^2+(-87.02-y_1)^2}+$$
$$\sqrt{(37.74-x_1)^2+(-95.73-y_1)^2}+\sqrt{(44.3-x_1)^2+(-106.55-y_1)^2}+$$
$$\sqrt{(33.15-x_1)^2+(-89.56-y_1)^2}+\sqrt{(31.02-x_1)^2+(-90.73-y_1)^2}$$

NO CONSTRAINTS

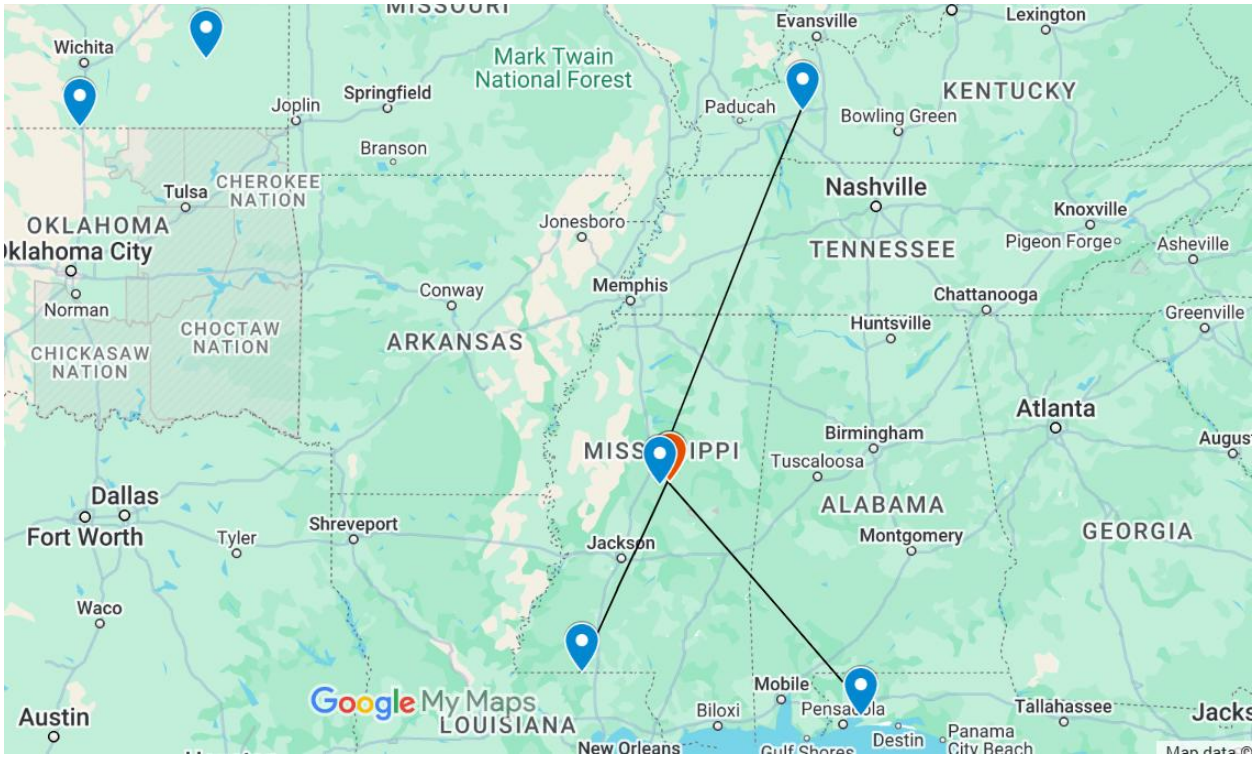
Decision Variables:
X_1= Location of new tower with respect to the x- axis
Y_2= Location of new tower with respect to the y axis

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)*
- *A text explanation of what your model is recommending*
- *Update your graph from the EDA section by adding in your new DC and add indicators of which Stores are serviced by which DC*

						Lat	Long								
					New DC:	33.14997	-89.56								
														last_year_demand	expected_yoy_change
														1974.73	-0.09
	Store Location		Current DC			New DC			Model Decision					2123.86	-0.12
store_name	lat	long	Lat	Long	Current DC Dist	Lat	Long	New DC Dist	Use New?	Dist	Difference	Demand		1459.55	-0.11
Starting Point	37.0275	-97.4213	39.8	-97.1								Last Years	This Years	1490.18	0.12
Butter Pecan Bluff	37.19	-87.79	39.8	-97.1	9.67	33.14997	-89.56	4.4	TRUE	4.4	-177.7257	1974.73	1797.0043	2125	-0.08
Jelly River Delta	44.55	-103.68	39.8	-97.1	8.12	33.14997	-89.56	18.1	FALSE	8.1	-254.8632	2123.86	1868.9968	1535.78	0.09
Popping Candy Plains	37.77	-118.31	39.8	-97.1	21.31	33.14997	-89.56	29.1	FALSE	21.3	-160.5505	1459.55	1298.9995	1616.84	-0.05
Smores Summit	30.5	-87.02	39.8	-97.1	13.71	33.14997	-89.56	3.7	TRUE	3.7	178.8216	1490.18	1669.0016	1625.69	0.09
Sour Patch Prairie	37.74	-95.73	39.8	-97.1	2.47	33.14997	-89.56	7.7	FALSE	2.5	-170	2125	1955		
Strawberry Swirl Stream	44.3	-106.55	39.8	-97.1	10.47	33.14997	-89.56	20.3	FALSE	10.5	138.2202	1535.78	1674.0002		
Swedish Fish Shores	33.15	-89.56	39.8	-97.1	10.05	33.14997	-89.56	0.0	TRUE	0.0	-80.842	1616.84	1535.998		
Vanilla Chai Vortex	31.02	-90.73	39.8	-97.1	10.85	33.14997	-89.56	2.4	TRUE	2.4	146.3121	1625.69	1772.0021		



These are the locations that mostly approximate to the Dc's

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 particular DC services a store.*
    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***

						Lat	Long						
					New DC:	33.1499	-89.56						
	Store Location		Current DC			New DC			Model Decision				
store_name	lat	long	Lat	Long	Current DC Dist	Lat	Long	New DC Dist	Use New?	Dist	Difference	Demand	
												Last Years	This Years
Starting Point	37.0275	-97.421	39.8	-97.1									
Butter Pecan Bluff	37.19	-87.79	39.8	-97.1	9.67	33.1499	-89.56	4.4	TRUE	4.4	-177.7257	1974.73	1797.0043
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Vanilla Chai Vortex	31.02	-90.73	39.8	-97.1	10.85	33.1499	-89.56	2.4	TRUE	2.4	146.3121	1625.69	1772.0021
									Objective	75.9			
											TRUE	6774.006	
											FALSE	6796.9965	
											ABS	22.9905	

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

There is decreased demand between the old and new locations if we were to open a new one. The model is recommending not opening the new location as there will be a decrease in demand, and there are more. The distance might not be too bad, but it would be quite useless to have another one if there's not enough demand.

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

We started with a minimum distance of 52.9 in the first model, and then it increased to 75.9.