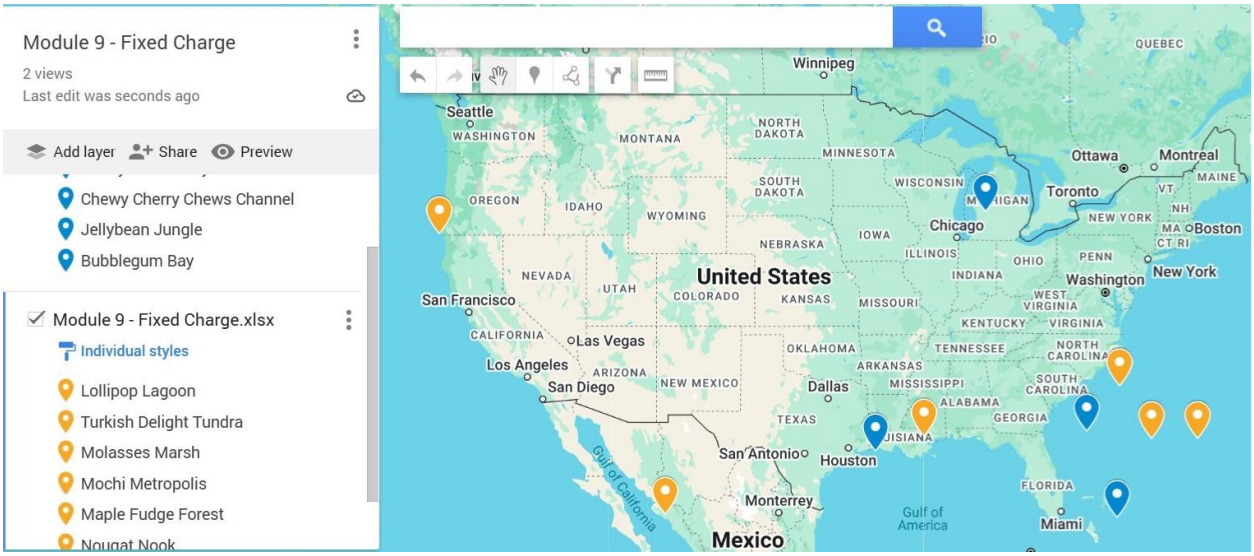
Module 09 – Fixed Charge Problem

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



Model Formulation

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.

MIN: X1 + X1 + X3 + X4 + 2831Y1 + 2008Y2 + 2277Y3 + 2707Y4

Constraints:

X11 + X21 + X31 + X41 <= 980
X12 + X22 + X32 + X42 <= 530
X13 + X23 + X33 + X43 <= 571
X14 + X24 + X34 + X44 <= 643
X15 + X25 + X35 + X45 <= 632
X16 + X26 + X36 + X46 <= 652
X1 – 3537 <= 0
X2 – 3537 <= 0
X3 – 3537 <= 0
X4 – 3537 <= 0

Model Optimized for Min Costs to Supply DCs

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*

WH	DC	WH LAT	WH LONG	DC LAT	DC LONG	MANHATTAN
1	1	43.27	-85.71	33.59	-76.09	19.3
1	2	43.27	-85.71	30.39	-73.86	24.73
1	3	43.27	-85.71	42.12	-124.66	40.1
1	4	43.27	-85.71	25.65	-108.54	40.45
1	5	43.27	-85.71	30.54	-90.09	17.11
1	6	43.27	-85.71	30.39	-70.61	27.98
2	1	30.82	-78.51	33.59	-76.09	5.19
2	2	30.82	-78.51	30.39	-73.86	5.08
2	3	30.82	-78.51	42.12	-124.66	57.45
2	4	30.82	-78.51	25.65	-108.54	35.2
2	5	30.82	-78.51	30.54	-90.09	11.86
2	6	30.82	-78.51	30.39	-70.61	8.33
3	1	25.44	-76.25	33.59	-76.09	8.31
3	2	25.44	-76.25	30.39	-73.86	7.34
3	3	25.44	-76.25	42.12	-124.66	65.09
3	4	25.44	-76.25	25.65	-108.54	32.5
3	5	25.44	-76.25	30.54	-90.09	18.94
3	6	25.44	-76.25	30.39	-70.61	10.59
4	1	29.6	-93.54	33.59	-76.09	21.44
4	2	29.6	-93.54	30.39	-73.86	20.47
4	3	29.6	-93.54	42.12	-124.66	43.64
4	4	29.6	-93.54	25.65	-108.54	18.95
4	5	29.6	-93.54	30.54	-90.09	4.39
4	6	29.6	-93.54	30.39	-70.61	23.72

WH>DC	1	2	3	4	5	6
1	19.3	24.73	40.1	40.45	17.11	27.98
2	5.19	5.08	57.45	35.2	11.86	8.33
3	8.31	7.34	65.09	32.5	18.94	10.59
4	21.44	20.47	43.64	18.95	4.39	23.72

WH>DC	1	2	3	4	5	6	SUM
1	0	0	0	0	0	0	0
2	980	530	0	0	0	652	2162
3	0	0	0	0	0	0	0
4	0	0	571	643	632	0	1846
USED	980	530	571	643	632	652	4008
DEMAND	980	530	571	643	632	652	4008

					TOTAL PROFIT	$ 57,802.53
SET UP COST	2831	2008	2277	2707		
BINARY VARIABLES	0	1	0	1	2	
LINKING CONSTRAINTS	0	-1846	0	-2162		

The model is recommending using Warehouse 2 and Warehouse 4 to meet the total demand across all six distribution centers while minimizing setup and transportation costs. This combination provides the optimal profit of $57,802.53 based on the current cost structure.

Model with Stipulation

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

Please perform 2 out of the 3 scenarios below with a short text description on what changed:

1. *Instead of only being able to open 2 warehouses, what happens to our objective function when we only can open 1 warehouse?*

					TOTAL PROFIT	$ 55,095.53
SET UP COST	2831	2008	2277	2707		
BINARY VARIABLES	0	1	0	0	1	
LINKING CONSTRAINTS	0	-1846	0	1846		

The cost decreased by $2000, from $57,802 compared to now $55,059.

2. *Right now, we have $1 per unit shipped over the distance between the warehouse and the DC. What happens to our objective function when we increase this to $30? Does your DC assignment change at all?*

   It does dramatically increase the total profit as well as switch around which warehouses are used.

TOTAL PROFIT	$ 2,410,587.52

3. *For distance between each location, we used Manhattan distance but what happens to our model if we use Euclidean distance instead? Did the change impact the model at all? Do you feel this is a better distance metric to use in this scenario?*