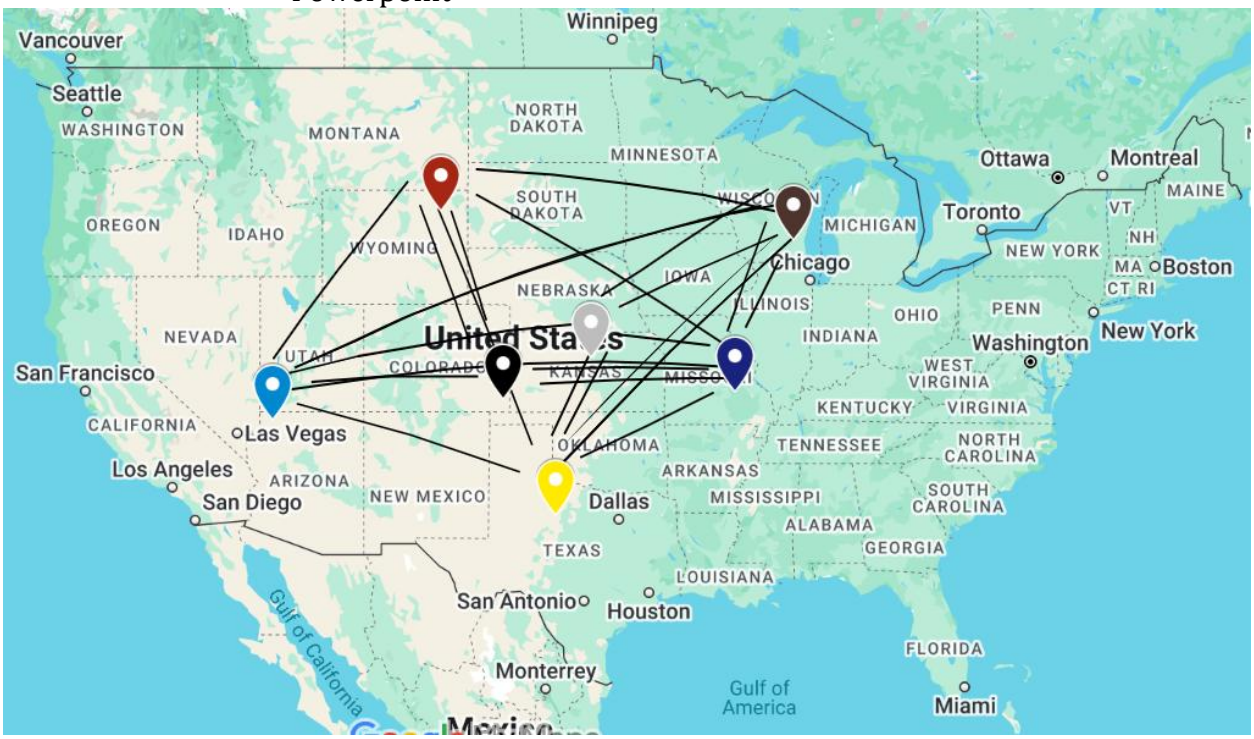
Module 10 – MOLP

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:

- *Choose **ONE** visualization method (expect 7 nodes and ~24 arcs):*
    - *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
    - *Make a visual graph of your data like what we saw for the sample problem*
        - https://excalidraw.com
        - https://mermaid.live
        - https://dreampuf.github.io/GraphvizOnline
        - Powerpoint



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. For this problem, I am only asking that you perform the model formulation for the MOLP model.

Constraints:

$X_{ij} \geq 0$

-X_13-X_15<=-9172
-X_27 +X_42<=1435
-X_34-X_36+X_13<=1733
-X_42+X_34<=1979
X_15<=1320
X_36<=1491
X_27<=1214
Weighted deviation % of all 4 objectives less than or equal to minimax

Objective: MiniMax
The overall deviation being used between min transport cost, min distance, min eco, and min congestion

Decision variables are all locations:
-X_1+X_2+X_3+X_4+X_5+X_6+X_7
MiniMax as well

Model Optimized for Equally Weighted Objectives
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 to indicate which arcs are used*

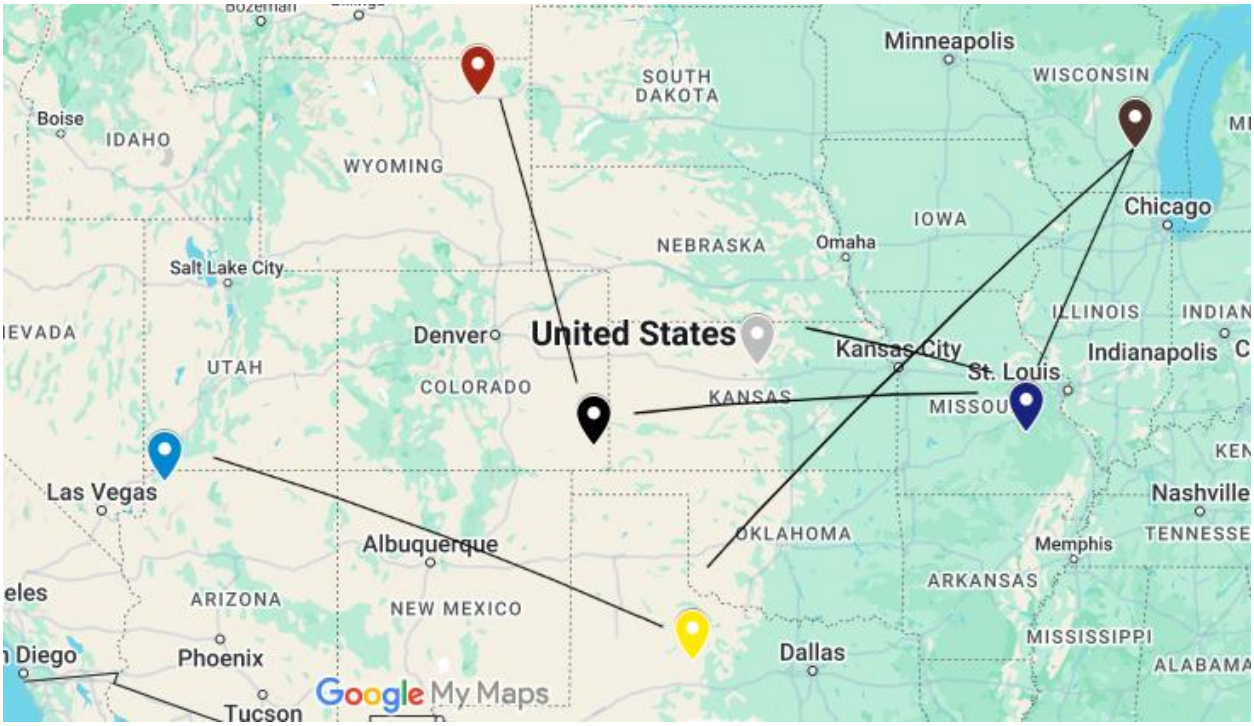
Objectives	Totals	Target Value	Deviation	% Deviation	Weight	Weighted Deviation %
Min Transport Cost	$180,549	$ 145,348	$35,201	24%	1	24%
Min Distance	250,723	194,764	55,959	29%	1	29%
Min Eco	10,663	10,663	-	0%	1	0%
Min Congestion	1,320	1,320	-	0%	1	0%

Objective	
MiniMax	29%

Ship	From	To	Unit Cost
7852	1	3	5
1320	1	5	10
0	2	3	13
0	2	4	15
0	2	5	15
0	2	6	17
1214	2	7	12
0	3	1	12
4628	3	4	11
1491	3	6	21
2649	4	2	7
0	4	3	22
0	4	6	22
0	4	7	16
0	5	1	17
0	5	3	23
0	5	4	10
0	5	7	9
0	6	2	5
0	6	4	13
0	7	1	16
0	7	3	11
0	7	4	8
0	7	6	5

Nodes	Inflow	Outflow	Netflow	Supply/Demand
1	0	9172	-9172	-9172
2	2649	1214	1435	1435
3	7852	6119	1733	1733
4	4628	2649	1979	1979
5	1320	0	1320	1320
6	1491	0	1491	1491
7	1214	0	1214	1214

My model recommends 7852 units be shipped from 1 to3, 1320 units shipped from 1 to 5, 1214 units from 2 to 7, 4628 units from 3 to 4, 1491 units from 3 to 6, and 2649 units from 4 to 2. There is an outflow of 9172 from node 1, net flow of 1435 for node 2, net flow of 1733 for node 3, 1979 net flow for node 4, 1320 inflow for node 5, 1491 inflow for node 6, and 1214 inflow for node 7.



Model with Stipulation

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

Alter the weights of each objective to add weight to match what matters most to you. Perhaps run a few different scenarios to see how the routes change depending on the weights. When you find a weight mix and solution that satisfies you, please write a justification on why you chose the final model/weights and about how a configured model like yours can be used for scenario planning.

I chose to increase the weight for transportation costs because I wanted to try and save the most money. This led to units being split more evenly outbound from node 1 between node 5 and 3. It also had units from 3 to 4, 4 to 2, 5 to 7, and 7 to 6 so it changed the overall solution. This can be used for scenario planning because the model can be optimized to focus on one objective while also slightly factoring other objectives without completely eliminating them. The advantage to this is you get a more balanced model and a better overall solution that incorporates multiple different things.