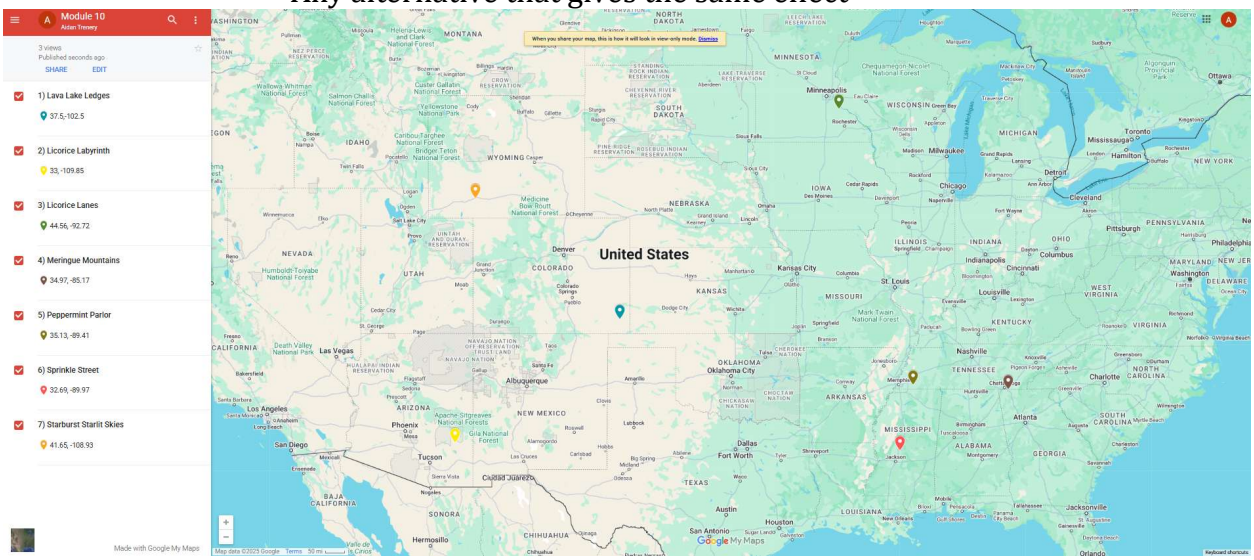
Module 10 – MOLP

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 a 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



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.

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*

$X1j \leq 8871$
$X2j \leq 1213$

X3j≤1728
X4j≤1304
X5j≤1401
X6j≤1549
X7j≤1676

Xi2≥1213
Xi3≥1728
Xi4≥1304
Xi5≥1401
Xi6≥1549
Xi7≥1676

Total Transportation Cost
MIN =13X13+8X14+10X15+14X16+16X17+2X24+7X25+21X27+11X35+5X36+22X37+15X43+15X45+14X46+7X47+6X51+22X52+15X62+10X63+19X64+14X65+21X73+8X74+6X76

Total Congestion
MIN =1X13+0X14+1X15+1X16+1X17+1X24+1X25+1X27+1X35+1X36+1X37+1X43+1X45+1X46+1X47+0X51+1X52+1X62+1X63+1X64+1X65+1X73+1X74+0X76

Total Eco-Friendly
MIN =0X13+1X14+0X15+0X16+0X17+0X24+0X25+0X27+0X35+0X36+0X37+1X43+0X45+0X46+1X47+1X51+0X52+1X62+0X63+0X64+1X65+1X73+1X74+0X76

Total Distance
MIN =12X13+18X14+13X15+13X16+8X17+25X24+21X25+9X27+10X35+12X36+16X37+12X43+4X45+5X46+25X47+13X51+21X52+20X62+13X63+5X64+3X65+16X73+25X74+21X76

Ship	From			To				Unit Cost	Distance	Eco Friendly	Congestion High/Low
	Latitude	Longitude		Latitude	Longitude						
1728	1 37.5	-102.5	Lava Cake Ledges	3 44.56	-92.72	Licorice Lanes	13	12.06201	0	1
1304	1 37.5	-102.5	Lava Cake Ledges	4 34.97	-85.17	Meringue Mountains	8	17.5137	1	0
1401	1 37.5	-102.5	Lava Cake Ledges	5 35.13	-89.41	Peppermint Parlor	10	13.30282	0	1
2762	1 37.5	-102.5	Lava Cake Ledges	6 32.69	-89.97	Sprinkle Street	14	13.42151	0	1
1676	1 37.5	-102.5	Lava Cake Ledges	7 41.65	-108.93	Starburst Starlit Skies	16	7.652934	0	1
0	2 33	-109.85	Licorice Labyrinth	4 34.97	-85.17	Meringue Mountains	8	24.7585	0	1
0	2 33	-109.85	Licorice Labyrinth	5 35.13	-89.41	Peppermint Parlor	7	20.55068	0	1
0	2 33	-109.85	Licorice Labyrinth	7 41.65	-108.93	Starburst Starlit Skies	21	8.698787	0	1
0	3 44.56	-92.72	Licorice Lanes	5 35.13	-89.41	Peppermint Parlor	11	9.994048	0	1
0	3 44.56	-92.72	Licorice Lanes	6 32.69	-89.97	Sprinkle Street	5	12.18439	0	1
0	3 44.56	-92.72	Licorice Lanes	7 41.65	-108.93	Starburst Starlit Skies	22	16.46913	0	1
0	4 34.97	-85.17	Meringue Mountains	3 44.56	-92.72	Licorice Lanes	15	12.20535	1	1
0	4 34.97	-85.17	Meringue Mountains	5 35.13	-89.41	Peppermint Parlor	15	4.243018	0	1
0	4 34.97	-85.17	Meringue Mountains	6 32.69	-89.97	Sprinkle Street	14	5.313982	0	1
0	4 34.97	-85.17	Meringue Mountains	7 41.65	-108.93	Starburst Starlit Skies	7	24.68117	1	1
0	5 35.13	-89.41	Peppermint Parlor	1 37.5	-102.5	Lava Cake Ledges	6	13.30282	1	1
0	5 35.13	-89.41	Peppermint Parlor	2 33	-109.85	Licorice Labyrinth	22	20.55068	0	0
1213	6 32.69	-89.97	Sprinkle Street	2 33	-109.85	Licorice Labyrinth	15	19.88242	1	1
0	6 32.69	-89.97	Sprinkle Street	3 44.56	-92.72	Licorice Lanes	10	12.18439	0	1
0	6 32.69	-89.97	Sprinkle Street	4 34.97	-85.17	Meringue Mountains	19	5.313982	0	1
0	6 32.69	-89.97	Sprinkle Street	5 35.13	-89.41	Peppermint Parlor	14	2.503438	1	1
0	7 41.65	-108.93	Starburst Starlit Skies	3 44.56	-92.72	Licorice Lanes	21	16.46913	1	1
0	7 41.65	-108.93	Starburst Starlit Skies	4 34.97	-85.17	Meringue Mountains	8	24.68117	1	1
0	7 41.65	-108.93	Starburst Starlit Skies	6 32.69	-89.97	Sprinkle Street	6	20.97053	0	0

	Nodes	Latitude	Longitude	Inflow	Outflow	Net Flow	Supply/Demand
1	Lava Cake Ledges	37.5	-102.5	0	8871	-8871	-8871
2	Licorice Labyrinth	33	-109.85	1213	0	1213	1213
3	Licorice Lanes	44.56	-92.72	1728	0	1728	1728
4	Meringue Mountains	34.97	-85.17	1304	0	1304	1304
5	Peppermint Parlor	35.13	-89.41	1401	0	1401	1401
6	Sprinkle Street	32.69	-89.97	2762	1213	1549	1549
7	Starburst Starlit Skies	41.65	-108.93	1676	0	1676	1676

	Objectives	Totals	Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
MIN	Cost	130585	94928.66053	35656.34	38%	1	38%
MIN	Distance	136332	96891.11351	39441.06	41%	1	41%
MIN	Eco-Friendly	2517	2224.637878	292.3621	13%	1	13%
MIN	Congestion	8780	6582.027	2197.973	33%	1	33%

Objective	
MiniMax	0.41

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.

In my updated run I shifted the weighting a bit: congestion still dominates, but it now carries 45 % of the score because steering clear of choke-points and meeting delivery windows is non-negotiable. I bumped distance up to 35 %, reflecting an even stronger push to curb fuel burn and shrink the carbon footprint, while cost settles at 20 %, leaving headroom to choose quicker, more reliable lanes even when they're a little pricier. This mix lets me play out "what-if" scenarios tight budgets, new emissions rules, sudden port slowdowns and instantly see how the route plan pivots, giving me a smarter, future-proof handle on the network.