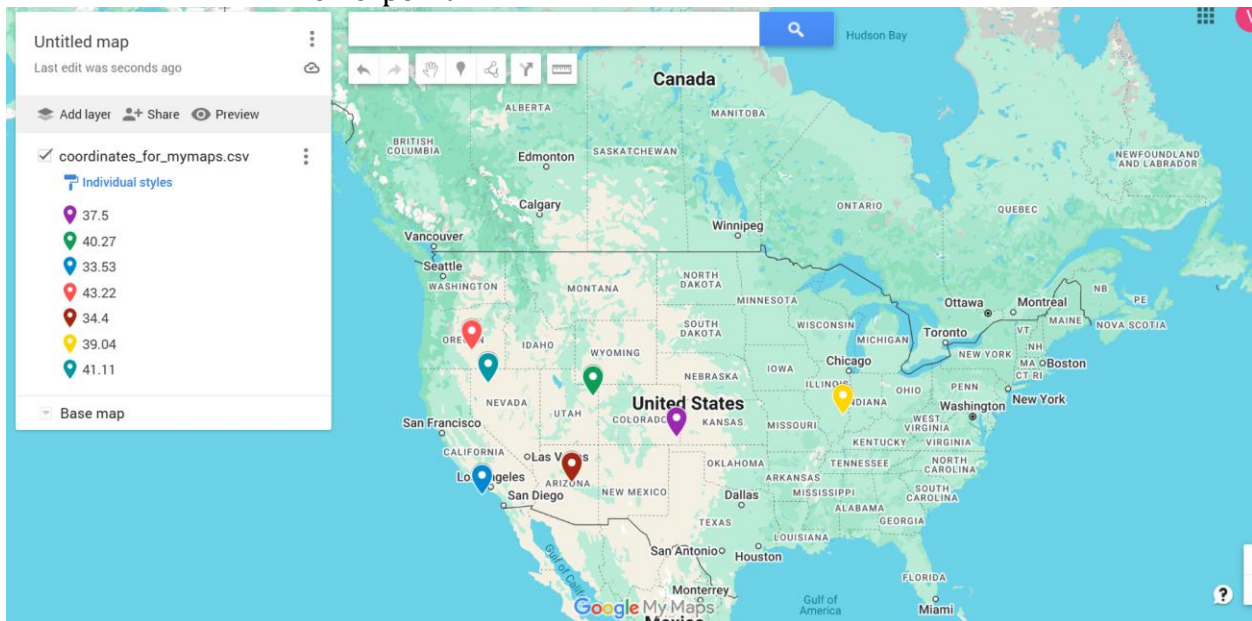


Module 10 – MOLP

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
 - 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



Untitled map - Google My Maps

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

The model recommends a transportation strategy that focuses primarily on minimizing total transportation cost while balancing environmental impact, congestion, and distance. The current weight distribution places equal importance on all four objectives, resulting in transportation cost having the lowest deviation from its target, while congestion has the highest deviation. This suggests that the chosen routes prioritize economic efficiency, utilizing lower-cost shipping methods even if they lead to slightly more congestion and environmental impact. The model highlights trade-offs among competing goals, indicating that in order to achieve cost savings, some compromise in eco-friendliness and traffic levels was necessary. This configuration could serve well in scenarios where budget constraints are tight, and sustainability remains important but not dominant.

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eco-friendliness	15595	8661.25302	56%	1	0.586610321																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					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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 final model, I prioritized eco-friendliness and congestion by assigning them the highest weights, followed by transportation cost and then total distance. This reflects a shift toward more sustainable supply chain strategies, where minimizing environmental impact and avoiding congestion are more critical than purely focusing on cost. Although cost remains important, it's balanced against long-term goals like reducing emissions and improving delivery efficiency. This type of configured model is valuable for scenario planning because it allows companies to test different priority settings and see how changes in regulation, fuel prices, or sustainability targets might impact their logistics decisions.

	from	to	cost_per_unit_shipped	latitude	longitude	latitude	longitude	Eco	transportation_method	congestion_level	Binary		Notes	Inflow	Outflow	Net flow	Supply/Demand
	9623	1	14	37.5	-102.5	43.22	-119.94	18,3540731	1 Diesel Trucks	32	0			1	0	9623	-9623
	0	17	19	37.5	-102.5	41.11	-118.56	16,4607121	1 Diesel Rail	80	1			2	1379	0	1379
	0	21	10	40.27	-109.63	37.5	-102.5	7,6491689	1 Air Freight	84	1			3	2796	1379	1417
	0	21	31	40.27	-109.63	33.53	-119.1	11,6236162	1 Diesel Trucks	12	1			4	9623	7787	1838
	0	25	14	40.27	-109.63	34.4	-111.46	6,14864213	1 Air Freight	95	1			5	1559	0	1559
	0	26	11	40.27	-109.63	39.04	-88.2	21,4652696	1 Air Freight	31	0			6	2235,57134	708,571337	1527
	1379	32	9	33.53	-119.1	40.27	-109.63	11,6326182	1 Diesel Rail	22	0			7	4140,57134	2235,57134	1905
	0	3	4	33.53	-119.1	43.22	-119.94	8,72634052	0 Wind-powered Ships	53	0						
	0	35	16	33.53	-119.1	34.4	-111.46	7,6893759	0 Electric/Hybrid Trucks	88	1	Total distance Traveled	332737.1035			247799.133	
	0	36	19	33.53	-119.1	39.04	-88.2	31,3874195	0 Electrified Rail	70	1						
	0	37	13	33.53	-119.1	41.11	-118.56	7,59921049	1 Diesel Trucks	81	1						
2087,4289663	43	3	7	43.22	-119.94	33.53	-119.1	9,72634052	1 Diesel Rail	84	1	Eco-Friendliness				Target Value	
	11	5	43.22	-119.94	34.4	-111.46	12,22353096	1 Carg Ship	70	1			217,331,4267				15595
4140,571337	47	9	43.22	-119.94	41.11	-118.56	5,52121003	1 Carg Ship (Heavy Fuel Oil)	29	0							
	0	52	6	34.4	-111.46	40.27	-109.63	6,14864213	0 Wind-powered Ships	67	1	Congestion Levels				Target Value	
	0	54	7	34.4	-111.46	43.22	-119.94	12,2353096	0 Electrified Rail	98	1		3646,428663			1559	
	0	56	18	34.4	-111.46	39.04	-88.2	23,7182883	1 Diesel Trucks	92	1						
	0	57	7	34.4	-111.46	41.11	-118.56	7,6893759	1 Carg Ship (Heavy Fuel Oil)	84	1						
	0	61	5	39.04	-88.2	37.5	-102.5	14,382684	1 Diesel Trucks	25	0	Total Transportation Costs				Target Value	
	0	62	21	39.04	-88.2	40.27	-109.63	21,4652696	0 Wind-powered Ships	110	1		23375.7108			202298	
708,5713366	63	3	16	39.04	-88.2	33.53	-119.1	31,3874195	1 Carg Ship (Heavy Fuel Oil)	27	0						
	0	64	11	39.04	-88.2	43.22	-119.94	32,1040564	0 Electrified Rail	85	1	Totals	Target Value	Variation	% Deviation	Weight	Weighted Deviation %
	0	71	11	41.11	-118.56	37.5	-102.5	16,4607121	1 Air Freight	25	0	total transportation	202298	31509,7108	15%	2	0.011625208
												total distance	247799.193	57903.9102	21%	10	2.108372646
												total eco-friendliness	15505	6228.14267	40%	10	4.016860802
2235,571337	716	6	20	41.11	-118.56	39.04	-88.2	30,3408664	1 Diesel Trucks	29	0	total congestion	1559	6228.14266	134%	3	4.016860808
												Minimum Variations					