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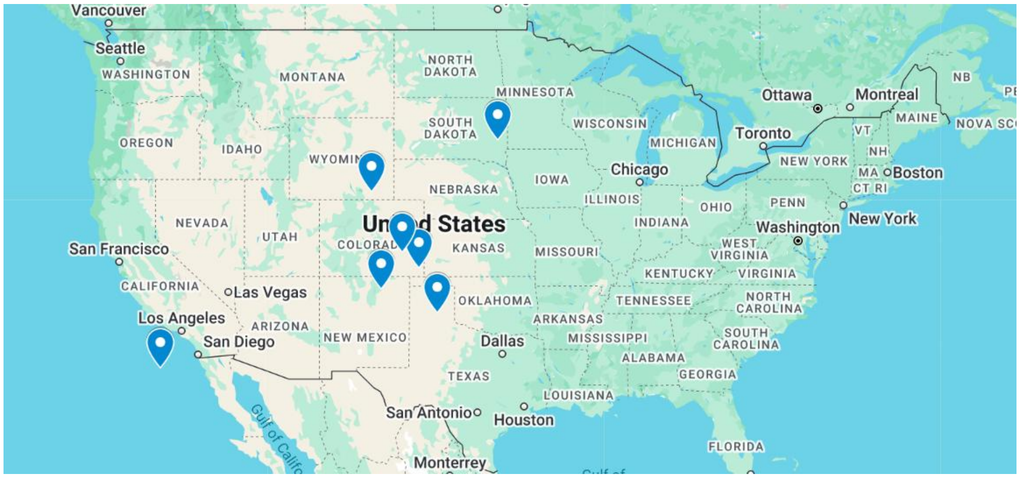
Module 10 – MOLP

Exploratory Data Analysis



Model Formulation

Objective: minimize Minimax Variable (Z)

Variables: Units Shipped and Minimax

Constraints:
1. Net flow = Outflow – Inflow = Supply.Demand
2. Units Shipped >= 0
3. Weighted Deviance <= Z

Model Optimized for Equally Weighted Objectives

Ship	From		To		Unit Cost	From Long	From Lati	To Long	To Lati	Distance	Unit distance	Transportation_method	Binary transport	Congestion Level	Binary Congest
3012.1	1	Caramel Cascades	2	Coconut Cluster Caves	$ 22.00	-102.5	37.5	-103.63	38.35	1.41	4259	Electric/Hybrid Trucks	0	77	1
2571.69	1	Caramel Cascades	5	Lava Lollipop Land	$ 23.00	-102.5	37.5	-101.22	35.13	2.69	6927	Diesel Trucks	1	33	0
1266	1	Caramel Cascades	6	Strawberry Swirl Stream	$ 15.00	-102.5	37.5	-97.22	43.98	8.36	10582	Diesel Trucks	1	95	1
2636.22	1	Caramel Cascades	7	Sugar Swirl Spires	$ 18.00	-102.5	37.5	-119.79	32.02	18.14	47815	Diesel Trucks	1	32	0
0	2	Coconut Cluster Caves	1	Caramel Cascades	$ 6.00	-103.63	38.35	-102.5	37.5	1.41	0	Electrified Rail	0	91	1
776.315	2	Coconut Cluster Caves	3	Coconut Macaroon Moor	$ 16.00	-103.63	38.35	-105.63	41.43	3.67	2851	Electric/Hybrid Trucks	0	27	0
735.782	2	Coconut Cluster Caves	4	Fruit Chew Fjords	$ 9.00	-103.63	38.35	-104.99	36.39	2.39	1755	Diesel Trucks	1	76	1
0	2	Coconut Cluster Caves	6	Strawberry Swirl Stream	$ 17.00	-103.63	38.35	-97.22	43.98	8.53	0	Cargo Ships (Heavy Fuel Oil)	1	91	0
0	3	Coconut Macaroon Moor	1	Caramel Cascades	$ 16.00	-105.63	41.43	-102.5	37.5	5.02	0	Diesel Trucks	1	97	0
0	3	Coconut Macaroon Moor	5	Lava Lollipop Land	$ 23.00	-105.63	41.43	-101.22	35.13	7.69	0	Cargo Ships (Heavy Fuel Oil)	1	91	0
0	3	Coconut Macaroon Moor	6	Strawberry Swirl Stream	$ 14.00	-105.63	41.43	-97.22	43.98	8.79	0	Slow Steaming Cargo Ships	0	72	1
0	3	Coconut Macaroon Moor	7	Sugar Swirl Spires	$ 14.00	-105.63	41.43	-119.79	32.02	17.00	0	Electric/Hybrid Trucks	0	102	1
0	4	Fruit Chew Fjords	3	Coconut Macaroon Moor	$ 23.00	-104.99	36.39	-105.63	41.43	5.08	0	Cargo Ships (Heavy Fuel Oil)	1	99	1
0	4	Fruit Chew Fjords	7	Sugar Swirl Spires	$ 19.00	-104.99	36.39	-119.79	32.02	15.43	0	Diesel Trucks	1	80	1
0	5	Lava Lollipop Land	1	Caramel Cascades	$ 17.00	-101.22	35.13	-102.5	37.5	2.69	0	Diesel Rail	1	95	1
0	5	Lava Lollipop Land	2	Coconut Cluster Caves	$ 13.00	-101.22	35.13	-103.63	38.35	4.02	0	Diesel Trucks	1	85	1
825.685	5	Lava Lollipop Land	3	Coconut Macaroon Moor	$ 17.00	-101.22	35.13	-105.63	41.43	7.69	6350	Diesel Rail	1	19	0
0	6	Strawberry Swirl Stream	2	Coconut Cluster Caves	$ 20.00	-97.22	43.98	-103.63	38.35	8.53	0	Slow Steaming Cargo Ships	0	78	1
0	6	Strawberry Swirl Stream	3	Coconut Macaroon Moor	$ 17.00	-97.22	43.98	-105.63	41.43	8.79	0	Cargo Ships (Heavy Fuel Oil)	1	78	1
0	6	Strawberry Swirl Stream	4	Fruit Chew Fjords	$ 16.00	-97.22	43.98	-104.99	36.39	10.86	0	Diesel Trucks	1	92	1
0	6	Strawberry Swirl Stream	7	Sugar Swirl Spires	$ 17.00	-97.22	43.98	-119.79	32.02	25.54	0	Electrified Rail	0	86	1
665.218	7	Sugar Swirl Spires	4	Fruit Chew Fjords	$ 23.00	-119.79	32.02	-104.99	36.39	15.43	10265	Diesel Rail	1	88	1
0	7	Sugar Swirl Spires	5	Lava Lollipop Land	$ 16.00	-119.79	32.02	-101.22	35.13	18.83	0	Diesel Trucks	1	80	1
0	7	Sugar Swirl Spires	6	Strawberry Swirl Stream	$ 7.00	-119.79	32.02	-97.22	43.98	25.54	0	Air Freight	1	103	1

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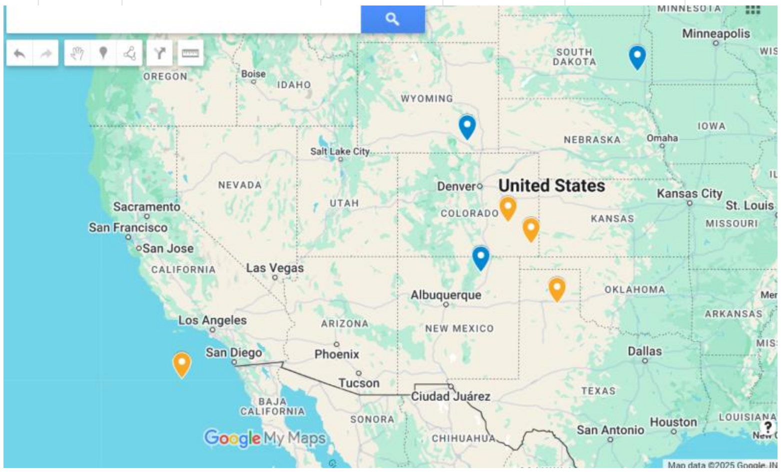
Nodes		Inflow	Outflow	Net Flow	Supply/Demand
1	Caramel Cascades	0	9486	-9486	-9486
2	Coconut Cluster Caves	3012.096625	1512.096625	1500	1500
3	Coconut Macaroon Moor	1602	0	1602	1602
4	Fruit Chew Fjords	1401	0	1401	1401
5	Lava Lollipop Land	2571.685263	825.6852629	1746	1746
6	Strawberry Swirl Stream	1266	0	1266	1266
7	Sugar Swirl Spires	2636.218112	665.2181121	1971	1971

location_id	latitude	longitude
1	37.5	-102.5
2	38.35	-103.63
3	41.43	-105.63
4	36.39	-104.99
5	35.13	-101.22
6	43.98	-97.22
7	32.02	-119.79

	Totals	Target	Deviation	Deviation %	Weight	Weight Deviation
Total Transportation Cost	$240,236.55	**$222,321.00**	$ 17,915.55	8.06%	1	8.06%
Distance Travelled	90804.39878	**66627.13363**	24177.26515	36.29%	1	36.29%
Ecofriendliness	8700.588638	**6384**	2316.588638	36.29%	1	36.29%
Congestion levels	5679.096625	**4167**	1512.096625	36.29%	1	36.29%

Minimax Variable	0.36



The model recommends a transportation network that balances cost-efficiency with environmental impact and congestion levels by selectively activating specific arcs. It prioritizes routes that offer a favorable trade-off between low cost and sustainability, often opting for electric or rail-based transport where possible. While the total cost slightly exceeds the initial target, the solution strategically distributes flow to avoid highly congested paths and reduce the overall environmental footprint. This results in a practical, optimized routing plan that supports operational goals while considering broader social and ecological constraints.

Model with Stipulation

	Totals	Target	Deviation	Deviation %	Weight	Weight Deviation
Total Transportation Cost	$ 238,976.30	**$ 222,321.00**	$ 16,655.30	7.49%	5	37.46%
Distance Travelled	87594.82951	**66627.13363**	20967.69589	31.47%	1	31.47%
Ecofriendliness	7088.32977	**6384**	704.3297696	11.03%	5	55.16%
Congestion levels	6465.67023	**4167**	2298.67023	55.16%	1	55.16%

Minimax Variable	0.55

In this version of the model, I prioritized Total Transportation Cost and Ecofriendliness, assigning each a weight of 5, while Distance Travelled and Congestion Levels received a lower priority with a weight of 1.

- Rationale for Cost Weight (5): As a supply chain student focused on logistics, cost-efficiency is typically the foremost objective for real-world network design. A small deviation in cost (7.49%) already aligns closely with the target, and weighting it heavily ensures it remains a central focus.

- Rationale for Ecofriendliness Weight (5): Sustainability is becoming increasingly crucial in logistics planning. A balanced supply chain must account for environmental impact, so I emphasized ecofriendliness even if it requires compromises elsewhere (e.g., longer travel times or congestion).

- Rationale for Lower Distance & Congestion Weights (1): While these are important, they're more flexible in this scenario. Distance is partially reflected in fuel use (already captured in cost), and congestion can often be addressed operationally with scheduling rather than routing.