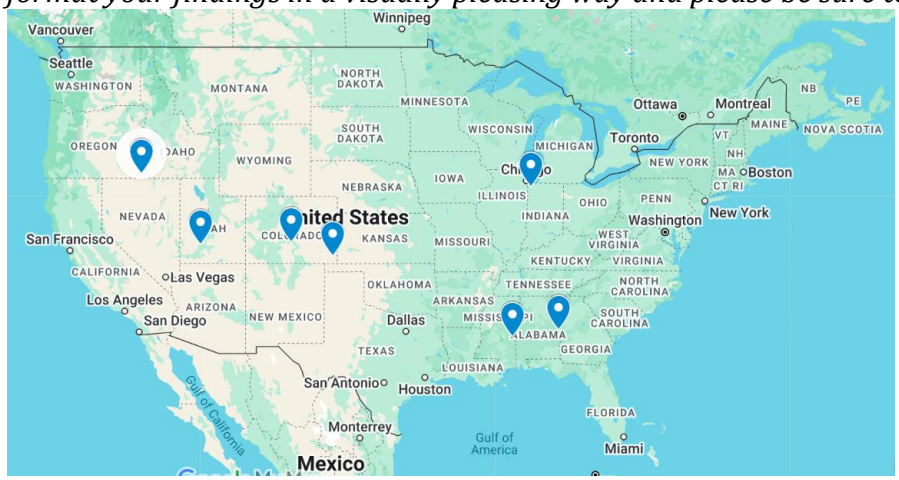
Module 10 – MOLP

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:



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.

Decision Variables:

Xij = # of units being shipped from node i to node j

Objective Function:

W1(17X14+24X15+24X16+10X17+20X23+10X24+19X32+14X34+10X37+24X45+16X51+11X52+10X53+24X54+7X57+15X61+18X62+23X63+24X64+11X65+21X67+8X71+24X72+16X73-221,527/221,527)<=Q

W2(17.87X14+3.23X15+14.62X16+15.36X17+25.48X23+8.87X24+25.48X32+27.91X34+6.06X37+21.10X45+3.23X51+18.53X52+7.01X53+21.10X54+12.14X57+14.62X61+9.21X62+24.53X63+3.59X64+17.83X65+29.97X67+15.36X71+29.74X72+6.06X73-147,229/147,229)<=Q

W3(X14+X15+X16+X17+X23+X24+X32+X37+X51+X52+X53+X54+X57+X61+X62+X63+X64+X67+X71+X72+X73-12,993/12,993)<=Q

W4(X14+X15+X16+X17+X23+X24+X32+X37+X45+X51+X52+X53+X54+X57+X61+X62+X63+X64+X65+X67+X71+X72+X73-12,993/12,993)<=Q

Constraints:

Xij>=0

W1,W2,W3,W4<=Q

Xi Net Flow>=Xi Supply/Demand

Model Optimized for Equally Weighted Objectives

Implement your formultion 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*

Ship	From		To		Unit Shipping Cost	Candy To Be Transported	Distance Traveled (Euclidean)	Transportation Method	Non Environment Friend	Congestion Binary	Congestion Level
1845	1	Chocolate Chip Cliffs	4	Licorice Lanes	$ 17	0	17.87	Air Freight	1	1	102
4123.89	1	Chocolate Chip Cliffs	5	Pudding Peaks	$ 24	0	3.23	Cargo Ships (Heavy Fuel Oil)	1	1	95
1766	1	Chocolate Chip Cliffs	6	Starburst Starlit Skies	$ 24	0	14.62	Diesel Rail	1	1	98
2039.11	1	Chocolate Chip Cliffs	7	Tartberry Thicket	$ 10	0	15.36	Diesel Rail	1	1	98
0	2	Cotton Candy Clouds	3	Lava Lollipop Land	$ 20	0	25.48	Cargo Ships (Heavy Fuel Oil)	1	1	95
0	2	Cotton Candy Clouds	4	Licorice Lanes	$ 10	0	8.87	Diesel Trucks	1	1	95
0	3	Lava Lollipop Land	2	Cotton Candy Clouds	$ 19	0	25.48	Diesel Rail	1	1	98
0	3	Lava Lollipop Land	4	Licorice Lanes	$ 14	0	27.91	Wind-powered Ships	0	0	28
0	3	Lava Lollipop Land	7	Tartberry Thicket	$ 10	0	6.06	Cargo Ships (Heavy Fuel Oil)	1	1	95
0	4	Licorice Lanes	5	Pudding Peaks	$ 24	5	21.10	Electric/Hybrid Trucks	0	1	76
0	5	Pudding Peaks	1	Chocolate Chip Cliffs	$ 16	0	3.23	Diesel Rail	1	1	98
1884	5	Pudding Peaks	2	Cotton Candy Clouds	$ 11	0	18.53	Air Freight	1	1	102
841.885	5	Pudding Peaks	3	Lava Lollipop Land	$ 10	0	7.01	Cargo Ships (Heavy Fuel Oil)	1	1	95
0	5	Pudding Peaks	4	Licorice Lanes	$ 24	0	21.10	Air Freight	1	1	102
0	5	Pudding Peaks	7	Tartberry Thicket	$ 7	0	12.14	Cargo Ships (Heavy Fuel Oil)	1	1	95
0	6	Starburst Starlit Skies	1	Chocolate Chip Cliffs	$ 15	0	14.62	Diesel Trucks	1	1	95
0	6	Starburst Starlit Skies	2	Cotton Candy Clouds	$ 18	0	9.21	Air Freight	1	1	102
0	6	Starburst Starlit Skies	3	Lava Lollipop Land	$ 23	0	24.53	Diesel Rail	1	1	98
0	6	Starburst Starlit Skies	4	Licorice Lanes	$ 24	0	3.59	Diesel Trucks	1	1	95
0	6	Starburst Starlit Skies	5	Pudding Peaks	$ 11	0	17.83	Electrified Rail	0	1	80
0	6	Starburst Starlit Skies	7	Tartberry Thicket	$ 21	0	29.97	Air Freight	1	1	102
0	7	Tartberry Thicket	1	Chocolate Chip Cliffs	$ 8	0	15.36	Diesel Trucks	1	1	95
0	7	Tartberry Thicket	2	Cotton Candy Clouds	$ 24	0	29.74	Diesel Rail	1	1	98
493.115	7	Tartberry Thicket	3	Lava Lollipop Land	$ 16	0	6.06	Diesel Trucks	1	1	95

Objectives	Totals	Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
Total Transportation Cost	$ 230,146.08	$ 221,527.00	$ 8,619.08	3.89%	1	4%
Total Distance Traveled	147,229	141,715	5,514	3.89%	1	4%
ECO-Friendliness	12,993	12,993	-	0.00%	1	0%
Congestion	12,993	12,993	-	0.00%	1	0%

MiniMax Variable->	4%

Nodes		Inflow	Outflow	Net Flow	Supply/Demand
1	Chocolate Chip Cliffs	0	9774	-9774	-9774
2	Cotton Candy Clouds	1884	0	1884	1884
3	Lava Lollipop Land	1335	0	1335	1335
4	Licorice Lanes	1845	0	1845	1845
5	Pudding Peaks	4123.89	2725.89	1398	1398
6	Starburst Starlit Skies	1766	0	1766	1766
7	Tartberry Thicket	2039.11	493.115	1546	1546

This model is recommending that the Fish and Murr's Candy Shop should ship 1845 units across route 14, about 4124 units across route 15, 1766 units across route 16, about 2039 units across route 17, 1884 units across route 52, about 842 units across route 53, and about 493 units across route 73.

Model with Stipulation

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

Objectives	Totals	Target Value	Deviation	% Deviation	Weight	Weighted% Deviation
Total Transportation Cost	$ 226,821.35	$ 221,527.00	$ 5,294.35	2.39%	3	7%
Total Distance Traveled	151,876	141,715	10,161	7.17%	1	7%
ECO-Friendliness	12,993	12,993	-	0.00%	4	0%
Congestion	12,993	12,993	-	0.00%	2	0%

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.

Ship	From		To		Unit Shipping Cost	Candy To Be Transported	Distance Traveled (Euclidear	Transportation Method	Non Environment Frie	Congestion Binary	Congestion Level
1845	1	Chocolate Chip Cliffs	4	Licorice Lanes	$ 17	0	17.87	Air Freight	1	1	102
3708.294	1	Chocolate Chip Cliffs	5	Pudding Peaks	$ 24	0	3.23	Cargo Ships (Heavy Fuel Oil	1	1	95
1766	1	Chocolate Chip Cliffs	6	Starburst Starlit Skies	$ 24	0	14.62	Diesel Rail	1	1	98
2454.706	1	Chocolate Chip Cliffs	7	Tartberry Thicket	$ 10	0	15.36	Diesel Rail	1	1	98
0	2	Cotton Candy Clouds	3	Lava Lollipop Land	$ 20	0	25.48	Cargo Ships (Heavy Fuel Oil	1	1	95
0	2	Cotton Candy Clouds	4	Licorice Lanes	$ 10	0	8.87	Diesel Trucks	1	1	95
0	3	Lava Lollipop Land	2	Cotton Candy Clouds	$ 19	0	25.48	Diesel Rail	1	1	98
0	3	Lava Lollipop Land	4	Licorice Lanes	$ 14	0	27.91	Wind-powered Ships	0	0	28
0	3	Lava Lollipop Land	7	Tartberry Thicket	$ 10	0	6.06	Cargo Ships (Heavy Fuel Oil	1	1	95
0	4	Licorice Lanes	5	Pudding Peaks	$ 24	5	21.10	Electric/Hybrid Trucks	0	1	76
0	5	Pudding Peaks	1	Chocolate Chip Cliffs	$ 16	0	3.23	Diesel Rail	1	1	98
1884	5	Pudding Peaks	2	Cotton Candy Clouds	$ 11	0	18.53	Air Freight	1	1	102
426.2944	5	Pudding Peaks	3	Lava Lollipop Land	$ 10	0	7.01	Cargo Ships (Heavy Fuel Oil	1	1	95
0	5	Pudding Peaks	4	Licorice Lanes	$ 24	0	21.10	Air Freight	1	1	102
0	5	Pudding Peaks	7	Tartberry Thicket	$ 7	0	12.14	Cargo Ships (Heavy Fuel Oil	1	1	95
0	6	Starburst Starlit Skies	1	Chocolate Chip Cliffs	$ 15	0	14.62	Diesel Trucks	1	1	95
0	6	Starburst Starlit Skies	2	Cotton Candy Clouds	$ 18	0	9.21	Air Freight	1	1	102
0	6	Starburst Starlit Skies	3	Lava Lollipop Land	$ 23	0	24.53	Diesel Rail	1	1	98
0	6	Starburst Starlit Skies	4	Licorice Lanes	$ 24	0	3.59	Diesel Trucks	1	1	95
0	6	Starburst Starlit Skies	5	Pudding Peaks	$ 11	0	17.83	Electrified Rail	0	1	80
0	6	Starburst Starlit Skies	7	Tartberry Thicket	$ 21	0	29.97	Air Freight	1	1	102
0	7	Tartberry Thicket	1	Chocolate Chip Cliffs	$ 8	0	15.36	Diesel Trucks	1	1	95
0	7	Tartberry Thicket	2	Cotton Candy Clouds	$ 24	0	29.74	Diesel Rail	1	1	98
908.7056	7	Tartberry Thicket	3	Lava Lollipop Land	$ 16	0	6.06	Diesel Trucks	1	1	95

I chose these weights for the final model because I want my candy shop to contribute to the well-being of the planet in every way possible. Due to this being an essential part of our business model, this was our highest priority and therefore had the highest weight. We also want to be efficient with our resources, which is why keeping total transportation costs as low as possible was our second-highest priority. A configured model like this can benefit our business, because if we get into a desperate financial situation where costs have to be minimized to as little as possible, we can boost the weight of the costs and lower our other priorities. Another situation that could arise is if we have a shortage of truck drivers, and we need to lower the number of miles that each driver has to travel in order to avoid them getting over tired and ending up in dangerous situations. The ability to adjust the weights to changing priorities makes a model like this very helpful to our candy business.