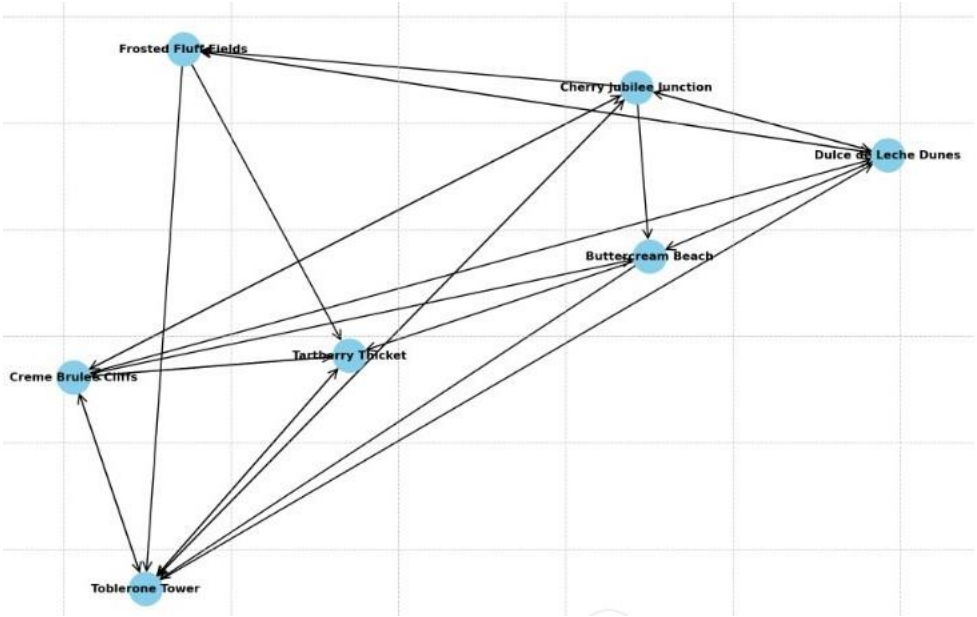
Module 10 – MOLP

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 like what we saw for the sample problem*



Model Formulation

Write the formulation of the model 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.

MIN: Q
W1 (((X1*A1) +(X2*A2) + … (X24*A24))-186191)/186191 ≤ Q
W2 (((X1*B1) +(X2*B2) + … (X24*B24))-100397)/100397 ≤ Q
W3 (((X1*C1) +(X2*C2) + … (X24*C24))-7972)/7972 ≤ Q
W4 (((X1*D1) +(X2*D2) + … (X24*D24))-8304)/8304 ≤ Q

Constraints:
X21 + X31 + X41 – X16 – X17 ≥ - 10720} Node 1
X32 + X42 + X72 – X21 - X23 - X24 - X25 - X27 ≥ 1849} Node 2
X23 + X63 + X73 – X31 - X32 - X34 - X36 - X37≥ 1743 } Node 3
X24 + X34 + X54 + X74 – X41 – X42 – X45 ≥ 1962} Node 4
X25 + X25 – X54 – X56 – X57 ≥ 1463} Node 5
X16 + X36 + X56 + X76 – X63 – X67 ≥ 1838} Node 6
X17 + X27 + X37 + X57 – X72 – X73 – X74 – X76 ≥ 1865} Node 7

Model Optimized for Equally Weighted Objectives

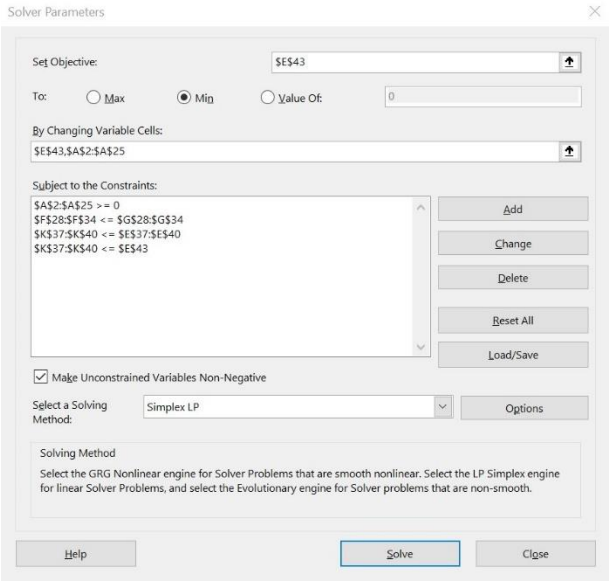
Implement your formulation into Excel and be sure to make it neat. This section should include:

- *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*

Ship	from		lat	long	to		lat	long	distance	transportation method	binary	congestion level	binary	Unit cost
2502.681	1	Buttercream Beach	37.5	-102.5	6	Tartberry Thicket	35.64	-111.47	9.160813	Air Freight	0	91	1	11
7256.319	1	Buttercream Beach	37.5	-102.5	7	Toblerone Tower	31.26	-117.57	16.31081	Air Freight	0	90	1	22
0	2	Cherry Jubilee Junction	40.67	-102.89	1	Buttercream Beach	37.5	-102.5	3.1939	Electric/Hybrid Trucks	1	32	0	6
1047.681	2	Cherry Jubilee Junction	40.67	-102.89	3	Creme Brulee Cliffs	35.23	-119.71	17.67784	Cargo Ships (Heavy Fuel Oil)	0	71	1	8
0	2	Cherry Jubilee Junction	40.67	-102.89	4	Dulce de Leche Dunes	39.4	-95.38	7.616627	Diesel Rail	0	82	1	21
0	2	Cherry Jubilee Junction	40.67	-102.89	5	Frosted Fluff Fields	41.39	-116.43	13.55913	Diesel Rail	0	81	1	16
0	2	Cherry Jubilee Junction	40.67	-102.89	7	Toblerone Tower	31.26	-117.57	17.43704	Diesel Rail	0	81	1	24
0	3	Creme Brulee Cliffs	35.23	-119.71	1	Buttercream Beach	37.5	-102.5	17.35906	Diesel Trucks	0	112	1	20
0	3	Creme Brulee Cliffs	35.23	-119.71	2	Cherry Jubilee Junction	40.67	-102.89	17.67784	Diesel Trucks	0	43	0	20
0	3	Creme Brulee Cliffs	35.23	-119.71	4	Dulce de Leche Dunes	39.4	-95.38	24.68477	Diesel Rail	0	88	1	17
0	3	Creme Brulee Cliffs	35.23	-119.71	6	Tartberry Thicket	35.64	-111.47	8.250194	Cargo Ships (Heavy Fuel Oil)	0	20	0	9
0	3	Creme Brulee Cliffs	35.23	-119.71	7	Toblerone Tower	31.26	-117.57	4.510044	Slow Steaming Cargo Ships	1	73	1	7
0	4	Dulce de Leche Dunes	39.4	-95.38	1	Buttercream Beach	37.5	-102.5	7.369152	Diesel Rail	0	91	1	19
0	4	Dulce de Leche Dunes	39.4	-95.38	2	Cherry Jubilee Junction	40.67	-102.89	7.616627	Diesel Trucks	0	82	1	21
0	4	Dulce de Leche Dunes	39.4	-95.38	5	Frosted Fluff Fields	41.39	-116.43	21.14385	Wind-powered Ships	1	97	1	19
0	5	Frosted Fluff Fields	41.39	-116.43	4	Dulce de Leche Dunes	39.4	-95.38	21.14385	Electrified Rail	1	94	1	23
0	5	Frosted Fluff Fields	41.39	-116.43	6	Tartberry Thicket	35.64	-111.47	7.593688	Diesel Rail	0	91	1	14
0	5	Frosted Fluff Fields	41.39	-116.43	7	Toblerone Tower	31.26	-117.57	10.19394	Cargo Ships (Heavy Fuel Oil)	0	26	0	23
0	6	Tartberry Thicket	35.64	-111.47	3	Creme Brulee Cliffs	35.23	-119.71	8.250194	Diesel Rail	0	82	1	22
0	6	Tartberry Thicket	35.64	-111.47	7	Toblerone Tower	31.26	-117.57	7.50962	Diesel Trucks	0	30	0	8
0	7	Toblerone Tower	31.26	-117.57	2	Cherry Jubilee Junction	40.67	-102.89	17.43704	Diesel Rail	0	93	1	22
2696.319	7	Toblerone Tower	31.26	-117.57	3	Creme Brulee Cliffs	35.23	-119.71	4.510044	Air Freight	0	98	1	14
1214	7	Toblerone Tower	31.26	-117.57	4	Dulce de Leche Dunes	39.4	-95.38	23.6359	Diesel Rail	0	87	1	12
1559	7	Toblerone Tower	31.26	-117.57	6	Tartberry Thicket	35.64	-111.47	7.50962	Diesel Trucks	0	82	1	23

	Nodes	Inflow	Outflow	Netflow	Supply/Demand
1	Buttercream Beach	0	9759	-9759	-10720
2	Cherry Jubilee Junction	0	1047.681	-1047.7	1849
3	Creme Brulee Cliffs	3744	0	3744	1743
4	Dulce de Leche Dunes	1214	0	1214	1962
5	Frosted Fluff Fields	0	0	0	1463
6	Tartberry Thicket	4061.680958	0	4061.7	1838
7	Toblerone Tower	7256.319042	5469.319	1787	1865

	Objectives	Totals		Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
MIN	Cost	283723.4		186191	97532.4	0.52383	1	52%
MIN	Distance	212365.8		100397	111969	1.11526	1	112%
MIN	Eco-Friendly	0		7972	-7972	-1	1	-100%
MIN	Congestion	16276		8304	7972	0.9600193	1	96%
	Objective							



The model aims to find the best way to move goods between locations while keeping costs, distance, congestion, and environmental impact as low as possible. It balances these factors equally to minimize the worst overall deviation from the target values. Focus on all factors equally as the deviation is the same for each one.

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.

	Objectives	Totals		Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
MIN	Cost	283723		186191	97532.4	0.52383	0.5	26%
MIN	Distance	212366		100397	111969	1.11526	0.5	56%
MIN	Eco-Friendly	0		7972	-7972	-1	0.5	-50%
MIN	Congestion	16276		8304	7972	0.9600193	0.5	48%
	Objective							
	MiniMax	0.21						

I chose to set all weights to 0.5 to balance each objective equally, reducing the impact of any single factor. This approach makes the model more flexible for different scenarios, as it can easily adjust to changing priorities**.**

	Objectives	Totals		Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
MIN	Cost	322953		186191	136762	0.7345253	5	367%
MIN	Distance	310322.7		100397	209926	2.0909558	1	209%
MIN	Eco-Friendly	1463		7972	-6509	-0.8164827	1	-82%
MIN	Congestion	19200		8304	10896	1.3121387	1	131%
	Objective							
	MiniMax	3.67						

I made this one as if this company is focusing more on minimizing transportation costs.

	Objectives	Totals		Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
MIN	Cost	354611		186191	168420	0.904555	1	90%
MIN	Distance	287590		100397	187193	1.8645274	1	186%
MIN	Eco-Friendly	0		7972	-7972	-1	5	-500%
MIN	Congestion	19200		8304	10896	1.3121387	1	131%
	Objective							
	MiniMax	1.86						

I made this one as if this company is focusing more on eco friendliness.