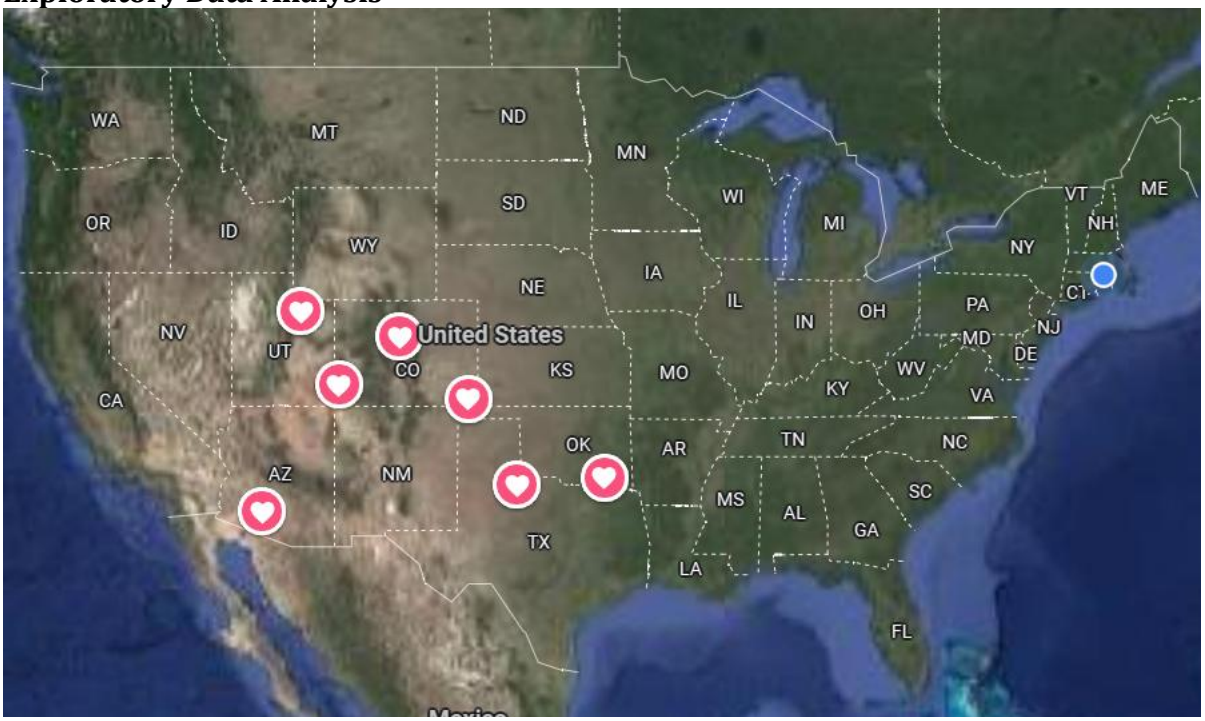
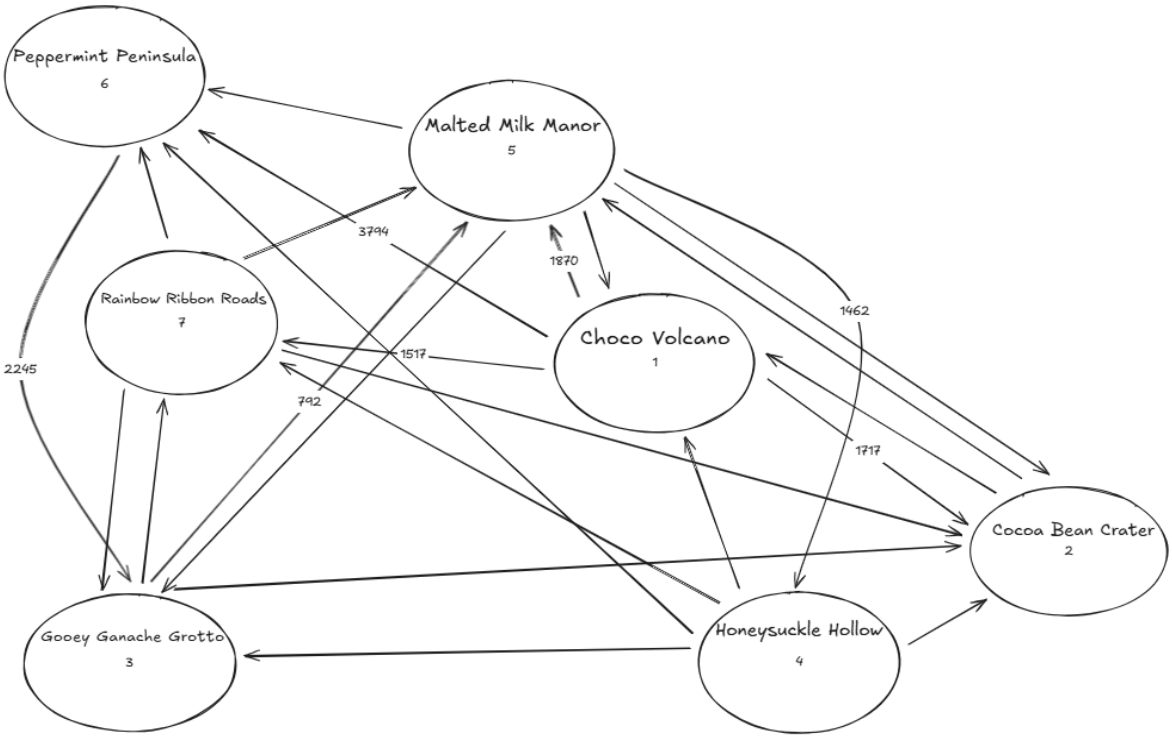
Module 10 – MOLP

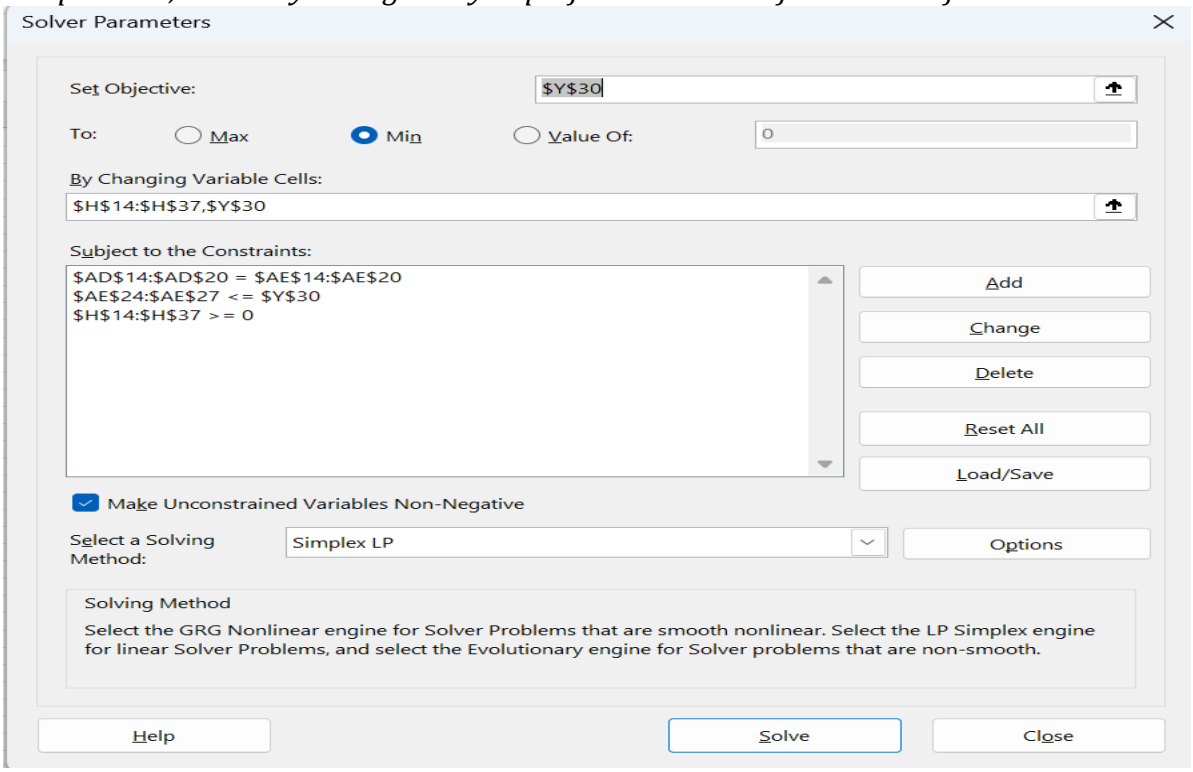
Exploratory Data Analysis





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.



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Model Optimized for Equally Weighted Objectives

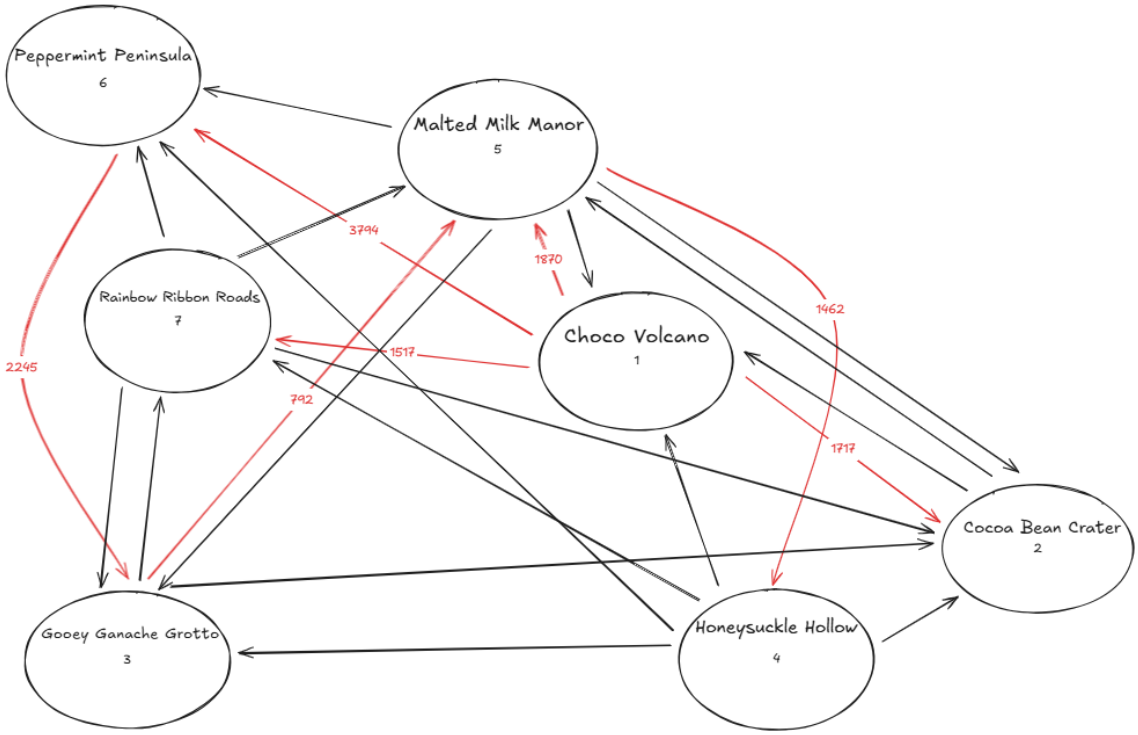
Ship	From		To		Transportation Method	Latitude (F)	Longitude (F)	Latitude (T)	Longitude (T)	Euclidian	ECO Binary	Congestion Level	Congestion Binary	Unit Cost
1717	1	Choco Volcano	2	Cocoa Bean Crater	Air Freight	37.5	-102.5	34.4	-95.88	7.30988372	1	103	1	$13
1870.333	1	Choco Volcano	5	Malted Milk Manor	Air Freight	37.5	-102.5	39.86	-105.08	3.496569748	1	83	1	$6
3793.667	1	Choco Volcano	6	Peppermint Peninsula	Wind-powered Ships	37.5	-102.5	40.81	-110.66	8.805776513	0	31	0	$8
1517	1	Choco Volcano	7	Rainbow Ribbon Roads	Diesel Trucks	37.5	-102.5	38.06	-108.82	6.344761619	1	87	1	$10
0	2	Cocoa Bean Crater	1	Choco Volcano	Air Freight	34.4	-95.88	37.5	-102.5	7.30988372	1	100	1	$8
0	2	Cocoa Bean Crater	5	Malted Milk Manor	Diesel Rail	34.4	-95.88	39.86	-105.08	10.69820546	1	105	1	$20
0	3	Gooey Ganache Grotto	2	Cocoa Bean Crater	Air Freight	33.02	-112.55	34.4	-95.88	16.72702305	1	83	1	$9
791.6668	3	Gooey Ganache Grotto	5	Malted Milk Manor	Electrified Rail	33.02	-112.55	39.86	-105.08	10.1284994	0	92	1	$16
0	3	Gooey Ganache Grotto	7	Rainbow Ribbon Roads	Diesel Rail	33.02	-112.55	38.06	-108.82	6.27012759	1	29	0	$13
0	4	Honeysuckle Hollow	1	Choco Volcano	Electric/Hybrid Trucks	34.12	-100.14	37.5	-102.5	4.122377955	0	28	0	$19
0	4	Honeysuckle Hollow	2	Cocoa Bean Crater	Cargo Ships (Heavy Fuel Oil)	34.12	-100.14	34.4	-95.88	4.269191961	1	87	1	$23
0	4	Honeysuckle Hollow	3	Gooey Ganache Grotto	Diesel Trucks	34.12	-100.14	33.02	-112.55	12.45865563	1	20	0	$14
0	4	Honeysuckle Hollow	6	Peppermint Peninsula	Wind-powered Ships	34.12	-100.14	40.81	-110.66	12.46701548	0	77	1	$5
0	4	Honeysuckle Hollow	7	Rainbow Ribbon Roads	Diesel Trucks	34.12	-100.14	38.06	-108.82	9.532365918	1	73	1	$23
0	5	Malted Milk Manor	1	Choco Volcano	Diesel Rail	39.86	-105.08	37.5	-102.5	3.496569748	1	35	0	$9
0	5	Malted Milk Manor	2	Cocoa Bean Crater	Air Freight	39.86	-105.08	34.4	-95.88	10.69820546	1	89	1	$17
0	5	Malted Milk Manor	3	Gooey Ganache Grotto	Diesel Trucks	39.86	-105.08	33.02	-112.55	10.1284994	1	77	1	$7
1462	5	Malted Milk Manor	4	Honeysuckle Hollow	Diesel Trucks	39.86	-105.08	34.12	-100.14	7.573057507	1	76	1	$8
0	5	Malted Milk Manor	6	Peppermint Peninsula	Diesel Trucks	39.86	-105.08	40.81	-110.66	5.660291512	1	90	1	$7
2244.667	6	Peppermint Peninsula	3	Gooey Ganache Grotto	Wind-powered Ships	40.81	-110.66	33.02	-112.55	8.015996507	0	90	1	$14
0	7	Rainbow Ribbon Roads	2	Cocoa Bean Crater	Diesel Rail	38.06	-108.82	34.4	-95.88	13.44764663	1	31	0	$24
0	7	Rainbow Ribbon Roads	3	Gooey Ganache Grotto	Diesel Rail	38.06	-108.82	33.02	-112.55	6.27012759	1	88	1	$13
0	7	Rainbow Ribbon Roads	5	Malted Milk Manor	Cargo Ships (Heavy Fuel Oil)	38.06	-108.82	39.86	-105.08	4.150614412	1	38	0	$11
0	7	Rainbow Ribbon Roads	6	Peppermint Peninsula	Diesel Trucks	38.06	-108.82	40.81	-110.66	3.30879132	1	110	1	$5

Nodes		Latitude	Longitude	Inflow	Outflow	Net Flow	Supply/Demand
1	Choco Volcano	37.5	-102.5	0	8898	-8898	-8898
2	Cocoa Bean Crater	34.4	-95.88	1717	0	1717	1717
3	Gooey Ganache Grotto	33.02	-112.55	2244.66675	791.6667531	1453	1453
4	Honeysuckle Hollow	34.12	-100.14	1462	0	1462	1462
5	Malted Milk Manor	39.86	-105.08	2662	1462	1200	1200
6	Peppermint Peninsula	40.81	-110.66	3793.66675	2244.666753	1549	1549
7	Rainbow Ribbon Roads	38.06	-108.82	1517	0	1517	1517

Objectives	Totals	Target Value	Deviation	% Deviation	Weight	Weighted % Deviation
Total Transportation Cost -->	$ 134,850.34	$ 96,440	$38,410.34	39.83%	1	39.83%
Total Distance Traveled -->	99205.45	74525	$24,680.12	33.12%	1	33.12%
Eco-Friendliness -->	6566.33	4696	$1,870.33	39.83%	1	39.83%
Congestion Levels -->	9602.67	8811	$791.67	8.98%	1	8.98%

Objective	
MiniMax Variable	0.40

The following model recommends that to minimize the Total Transportation Cost, minimize Total Distance Traveled, Increase the Eco-Friendliness, and minimize Congestion Levels between the 7 Warehouse locations, certain steps must be taken. Following the data graph listed above, they must maximize Net Flow by using all the available Supply/Demand that they have. In doing so, they will optimize total costs and efficiency standards by planning the most effective routes to run. Between the 24 possible combinations the business can choose from, demand can be filled with -8898, 1717, 1453, 1462, 1200, 1549, & 1517 sent/received to each warehouse while taking into account maximizing or minimizing each of the 4 MOLP Objectives, respectively. As a result, this sums up the total demand between all locations, equaling 13,396 units. By following this model, the business can prevent unnecessary spending, limit shipment mileage, remain environmentally conscious, and prevent bottlenecks tied to operating a transportation-based business. Thus, following these steps will satisfy each constraint of the MOLP model, or, in other words, optimize the Minimax Variable.


Peppermint Peninsula
6
Malted Milk Manor
5
Rainbow Ribbon Roads
7
Choco Volcano
1
Cocoa Bean Crater
2
Gooey Ganache Grotto
3
Honeysuckle Hollow
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3794
1870
1462
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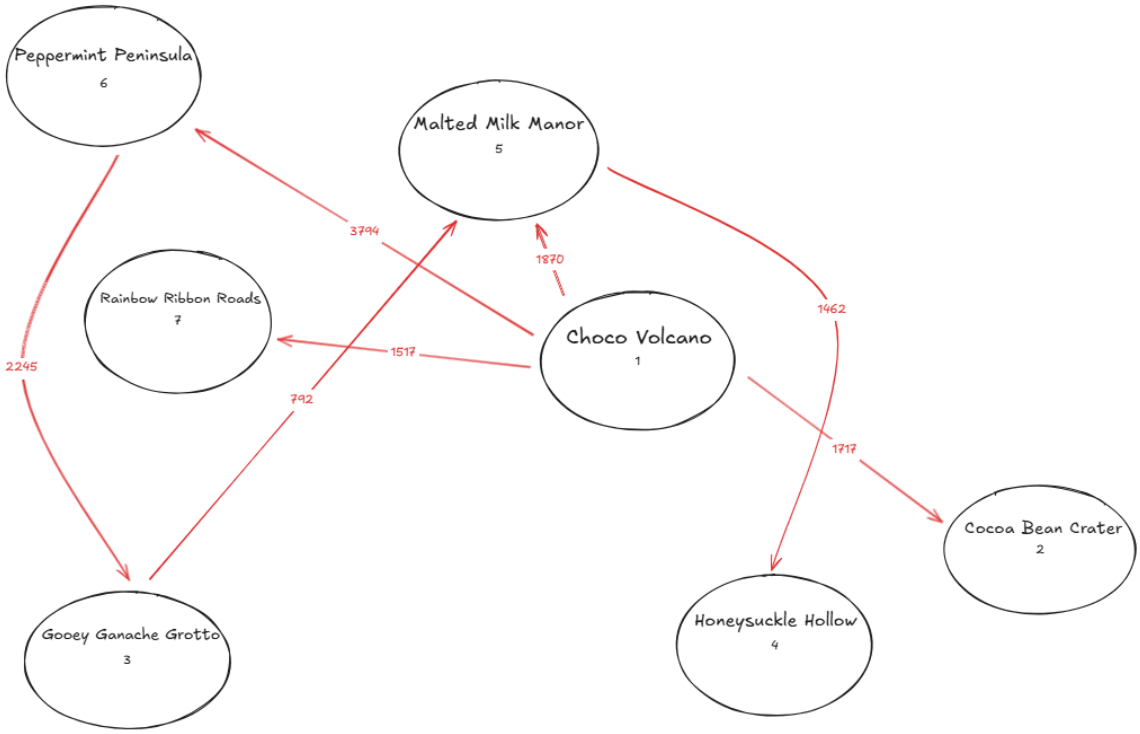
792
1717


Peppermint Peninsula
6
Malted Milk Manor
5
Rainbow Ribbon Roads
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Choco Volcano
1
Cocoa Bean Crater
2
Gooey Ganache Grotto
3
Honeysuckle Hollow
4
3794
1870
1462
2245
1517
792
1717

Model with Stipulation

Weight	Weighted % Deviation
1.25	**15.50%**
0.75	**5.75%**
0.25	**15.50%**
1.75	**2.47%**

The following adjusted weight used to in the Model 2.0 provides a more balanced and efficient solution concerning each of the 4 Objectives and the Minimax Variable. Using these new weights the Total Transportation Costs dropped nearly $26,000. This means the business will have more money to invest in other projects and award bonuses. The Total Distance Traveled also dropped nearly 19,000 units. This means the amount of time spent delivering goods would be optimized to include shorter routes rather than longer ones, saving fuel in the long run. Furthermore, the Congestion Level dropped 700 units as well. This means that shipment will spend less time in bottlenecks and will distribute itself more easily. Finally, consequently, the Eco-Friendliness does increase by about 900 units. This means that the business will focus more about being effective in their shipping patterns than efficient in the physical methods they use in transporting units. However, this is a cost the business should look into as it has 3 significant upsides while only holding 1 minor downside.