

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

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.

The screenshot shows the 'Solver Parameters' dialog box in Microsoft Excel. The 'Set Objective:' field is set to '\$T\$19'. The 'To:' section has three radio buttons: 'Max' (unselected), 'Min' (selected), and 'Value Of:' (set to 0). The 'By Changing Variable Cells:' field is set to '\$B\$11:\$B\$34,\$R\$41'. The 'Subject to the Constraints:' section contains three constraints: '\$B\$11:\$B\$34 >= 0', '\$Q\$11:\$Q\$17 = \$R\$11:\$R\$17', and '\$V\$35:\$V\$38 <= \$R\$41'. To the right of these constraints are buttons for 'Add', 'Change', 'Delete', 'Reset All', and 'Load/Save'. Below the constraints, the checkbox 'Make Unconstrained Variables Non-Negative' is checked. The 'Select a Solving Method:' dropdown is set to 'Simplex LP', and the 'Options' button is visible. At the bottom, there is a 'Solving Method' section with explanatory text: 'Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.' The bottom of the dialog has 'Help', 'Solve', and 'Close' buttons.

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	to	cost_per_unit_ship	Kelidus Distance	Total distance	transportation_method	Exc Rate	Congestion Len	Congestion Binary
0	1	2	6	3,947.333333	0	0	0	0	0
0	1	3	6	3,956.666667	0	0	0	0	0
0	1	4	6	3,966.000000	0	0	0	0	0
0	1	5	6	3,975.333333	0	0	0	0	0
0	1	6	6	3,984.666667	0	0	0	0	0
0	1	7	6	3,994.000000	0	0	0	0	0
0	1	8	6	4,003.333333	0	0	0	0	0
0	1	9	6	4,012.666667	0	0	0	0	0
0	1	10	6	4,022.000000	0	0	0	0	0
0	1	11	6	4,031.333333	0	0	0	0	0
0	1	12	6	4,040.666667	0	0	0	0	0
0	1	13	6	4,050.000000	0	0	0	0	0
0	1	14	6	4,059.333333	0	0	0	0	0
0	1	15	6	4,068.666667	0	0	0	0	0
0	1	16	6	4,078.000000	0	0	0	0	0
0	1	17	6	4,087.333333	0	0	0	0	0
0	1	18	6	4,096.666667	0	0	0	0	0
0	1	19	6	4,106.000000	0	0	0	0	0
0	1	20	6	4,115.333333	0	0	0	0	0
0	1	21	6	4,124.666667	0	0	0	0	0
0	1	22	6	4,134.000000	0	0	0	0	0
0	1	23	6	4,143.333333	0	0	0	0	0
0	1	24	6	4,152.666667	0	0	0	0	0
0	1	25	6	4,162.000000	0	0	0	0	0
0	1	26	6	4,171.333333	0	0	0	0	0
0	1	27	6	4,180.666667	0	0	0	0	0
0	1	28	6	4,190.000000	0	0	0	0	0
0	1	29	6	4,199.333333	0	0	0	0	0
0	1	30	6	4,208.666667	0	0	0	0	0
0	1	31	6	4,218.000000	0	0	0	0	0
0	1	32	6	4,227.333333	0	0	0	0	0
0	1	33	6	4,236.666667	0	0	0	0	0
0	1	34	6	4,246.000000	0	0	0	0	0
0	1	35	6	4,255.333333	0	0	0	0	0
0	1	36	6	4,264.666667	0	0	0	0	0
0	1	37	6	4,274.000000	0	0	0	0	0
0	1	38	6	4,283.333333	0	0	0	0	0
0	1	39	6	4,292.666667	0	0	0	0	0
0	1	40	6	4,302.000000	0	0	0	0	0
0	1	41	6	4,311.333333	0	0	0	0	0
0	1	42	6	4,320.666667	0	0	0	0	0
0	1	43	6	4,330.000000	0	0	0	0	0
0	1	44	6	4,339.333333	0	0	0	0	0
0	1	45	6	4,348.666667	0	0	0	0	0
0	1	46	6	4,358.000000	0	0	0	0	0
0	1	47	6	4,367.333333	0	0	0	0	0
0	1	48	6	4,376.666667	0	0	0	0	0
0	1	49	6	4,386.000000	0	0	0	0	0
0	1	50	6	4,395.333333	0	0	0	0	0
0	1	51	6	4,404.666667	0	0	0	0	0
0	1	52	6	4,414.000000	0	0	0	0	0
0	1	53	6	4,423.333333	0	0	0	0	0
0	1	54	6	4,432.666667	0	0	0	0	0
0	1	55	6	4,442.000000	0	0	0	0	0
0	1	56	6	4,451.333333	0	0	0	0	0
0	1	57	6	4,460.666667	0	0	0	0	0
0	1	58	6	4,470.000000	0	0	0	0	0
0	1	59	6	4,479.333333	0	0	0	0	0
0	1	60	6	4,488.666667	0	0	0	0	0
0	1	61	6	4,498.000000	0	0	0	0	0
0	1	62	6	4,507.333333	0	0	0	0	0
0	1	63	6	4,516.666667	0	0	0	0	0
0	1	64	6	4,526.000000	0	0	0	0	0
0	1	65	6	4,535.333333	0	0	0	0	0
0	1	66	6	4,544.666667	0	0	0	0	0
0	1	67	6	4,554.000000	0	0	0	0	0
0	1	68	6	4,563.333333	0	0	0	0	0
0	1	69	6	4,572.666667	0	0	0	0	0
0	1	70	6	4,582.000000	0	0	0	0	0
0	1	71	6	4,591.333333	0	0	0	0	0
0	1	72	6	4,600.666667	0	0	0	0	0
0	1	73	6	4,610.000000	0	0	0	0	0
0	1	74	6	4,619.333333	0	0	0	0	0
0	1	75	6	4,628.666667	0	0	0	0	0
0	1	76	6	4,638.000000	0	0	0	0	0
0	1	77	6	4,647.333333	0	0	0	0	0
0	1	78	6	4,656.666667	0	0	0	0	0
0	1	79	6	4,666.000000	0	0	0	0	0
0	1	80	6	4,675.333333	0	0	0	0	0
0	1	81	6	4,684.666667	0	0	0	0	0
0	1	82	6	4,694.000000	0	0	0	0	0
0	1	83	6	4,703.333333	0	0	0	0	0
0	1	84	6	4,712.666667	0	0	0	0	0
0	1	85	6	4,722.000000	0	0	0	0	0
0	1	86	6	4,731.333333	0	0	0	0	0
0	1	87	6	4,740.666667	0	0	0	0	0
0	1	88	6	4,750.000000	0	0	0	0	0
0	1	89	6	4,759.333333	0	0	0	0	0
0	1	90	6	4,768.666667	0	0	0	0	0
0	1	91	6	4,778.000000	0	0	0	0	0
0	1	92	6	4,787.333333	0	0	0	0	0
0	1	93	6	4,796.666667	0	0	0	0	0
0	1	94	6	4,806.000000	0	0	0	0	0
0	1	95	6	4,815.333333	0	0	0	0	0
0	1	96	6	4,824.666667	0	0	0	0	0
0	1	97	6	4,834.000000	0	0	0	0	0
0	1	98	6	4,843.333333	0	0	0	0	0
0	1	99	6	4,852.666667	0	0	0	0	0
0	1	100	6	4,862.000000	0	0	0	0	0
0	1	101	6	4,871.333333	0	0	0	0	0
0	1	102	6	4,880.666667	0	0	0	0	0
0	1	103	6	4,890.000000	0	0	0	0	0
0	1	104	6	4,899.333333	0	0	0	0	0
0	1	105	6	4,908.666667	0	0	0	0	0
0	1	106	6	4,918.000000	0	0	0	0	0
0	1	107	6	4,927.333333	0	0	0	0	0
0	1	108	6	4,936.666667	0	0	0	0	0
0	1	109	6	4,946.000000	0	0	0	0	0
0	1	110	6	4,955.333333	0	0	0	0	0
0	1	111	6	4,964.666667	0	0	0	0	0
0	1	112	6	4,974.000000	0	0	0	0	0
0	1	113	6	4,983.333333	0	0	0	0	0
0	1	114	6	4,992.666667	0	0	0	0	0
0	1	115	6	5,002.000000	0	0	0	0	0
0	1	116	6	5,011.333333	0	0	0	0	0
0	1	117	6	5,020.666667	0	0	0	0	0
0	1	118	6	5,030.000000	0	0	0	0	0
0	1	119	6	5,039.333333	0	0	0	0	0
0	1	120	6	5,048.666667	0	0	0	0	0
0	1	121	6	5,058.000000	0	0	0	0	0
0	1	122	6	5,067.333333	0	0	0	0	0
0	1	123	6	5,076.666667	0	0	0	0	0
0	1	124	6	5,086.000000	0	0	0	0	0
0	1	125	6	5,095.333333	0	0	0	0	0
0	1	126	6	5,104.666667	0	0	0	0	0
0	1	127	6	5,114.000000	0	0	0	0	0
0	1	128	6	5,123.333333	0	0	0	0	0
0	1	129	6	5,132.666667	0	0	0	0	0
0	1	130	6	5,142.000000	0	0	0	0	0
0	1	131	6	5,151.333333	0	0	0	0	0
0	1	132	6	5,160.666667	0	0	0	0	0
0	1	133	6	5,170.000000	0	0	0	0	0
0	1	134	6	5,179.333333	0	0	0	0	0
0	1	135	6	5,188.666667	0	0	0	0	0
0	1	136	6	5,198.000000	0	0	0	0	0
0	1	137	6	5,207.333333	0	0	0	0	0
0	1	138	6	5,216.666667	0	0	0	0	0
0	1	139	6	5,226.000000	0	0	0	0	0
0	1	140	6	5,235.333333	0	0	0	0	0
0	1	141	6	5,244.666667	0	0	0	0	0
0	1	142	6	5,254.000000	0	0	0	0	0
0	1	143	6	5,263.333333	0	0	0	0	0
0	1	144	6	5,272.666667	0	0	0	0	0
0	1	145	6	5,282.000000	0	0	0	0	0
0	1	146	6	5,291.333333	0	0	0	0	0
0	1	147	6	5,300.666667	0	0	0	0	0
0	1	148	6	5,310.000000	0	0	0	0	0
0	1	149	6	5,319.333333	0	0	0	0	0
0	1	150	6	5,328.666667	0	0	0	0	0
0	1	151	6	5,338.000000	0	0	0	0	0
0	1	152	6	5,347.333333	0	0	0	0	0
0	1	153	6	5,356.666667	0	0	0	0	0
0	1	154	6	5,366.000000	0	0	0	0	0
0	1	155	6	5,375.333333	0	0	0	0	0
0	1	156	6	5,384.666667	0	0	0	0	0
0	1	157	6	5,394.000000	0	0	0	0	0
0	1								