Module 09 – Fixed Charge Problem

Exploratory Data Analysis

Distribution Center

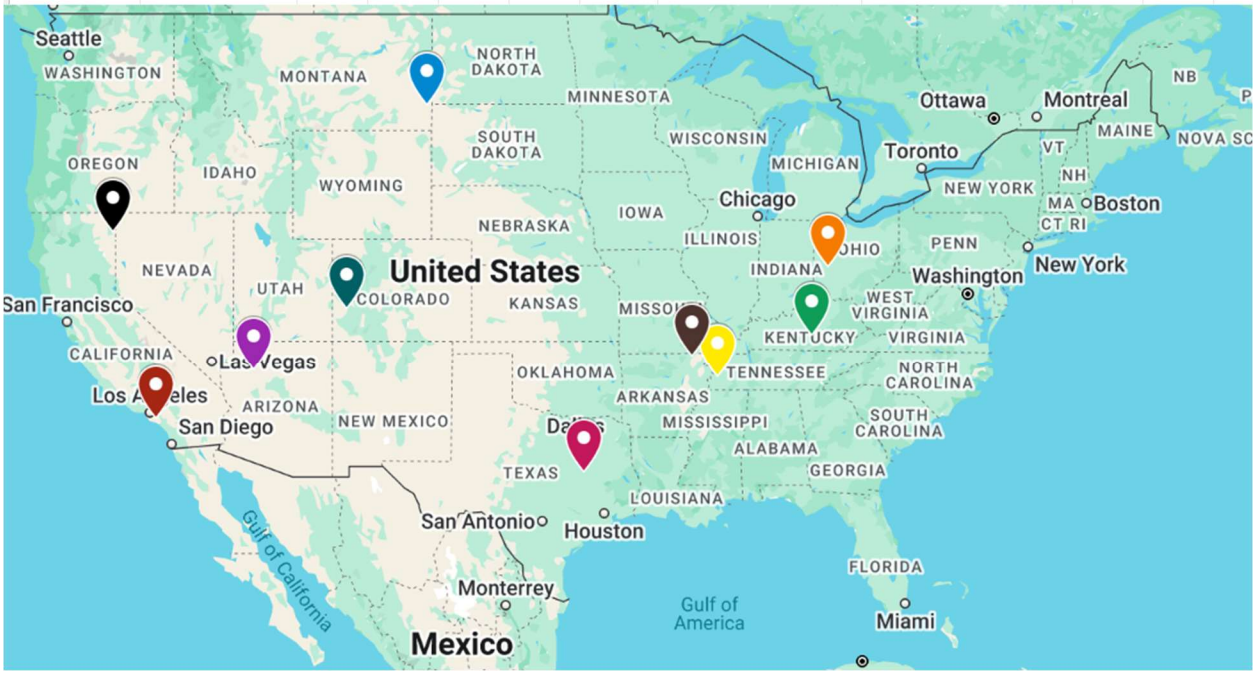
Distribution_center	Name	Demand	Latitude	Longitude
1	Sherbet Shoreline	811	45.97	-104.43
2	Snickerdoodle Slopes	897	35.87	-113.11
3	Sugarplum Springs	875	37.33	-85.03
4	Sugar Swirl Spires	643	35.63	-89.74
5	Mallow Melt Mountains	548	39.99	-84.19
6	Molasses Marsh	793	31.6	-96.46

Conditions

Max_dcs	Cost_per_unit_distance	Method_to_calculate_distance
2	1	manhattan

Warehouses

Warehouse	Name	Set_up_cost	Latitude	Longitude
1	Chewy Cherry Chews Channel	2224	33.85	-118.02
2	Ginger Snap Garden	2975	36.44	-91.05
3	Gooey Ganache Grotto	2468	41.28	-120.2
4	Fizzwhiz Fjord	2008	38.31	-108.45



Each point is color-coated with the same color on the excel sheet

Model Formulation

MIN: 25.71X11 + 6.93X12 + 36.47X13 + 30.06X14 + 39.97X15 + 23.81X16 + 22.91X21 + 22.63X22 + 6.91X23 + 2.21X24 + 10.41X25 + 10.25X26 + 20.46X31 + 12.5X32 + 39.12X33 + 36.11X34 + 37.3X35 + 33.42X36 + 11.68X41 + 7.1X42 + 24.4X43 + 21.39X44 + 25.94X45 + 18.7X46

Subject to:
X11 + X21 + X31 + X41 >= 811
X12 + X22 + X32 + X43 >= 897
X13 + X23 + X33 + X43 >= 875
X14 + X24 + X34 + X44 >= 643

X15 + X25 + X35 + X45 >= 548
X16 + X26 + X36 + X46 >= 793

Constraints:
=SUM of binary <= 2

Model Optimized for Min Costs to Supply DCs

WH v DC >	1	2	3	4	5	6
1	25.71	6.93	36.47	30.06	39.97	23.81
2	22.91	22.63	6.91	2.12	10.41	10.25
3	20.46	12.5	39.12	36.11	37.3	33.42
4	11.68	7.1	24.4	21.39	25.94	18.7

WH v DC >	1	2	3	4	5	6	SUM
1	0	0	0	0	0	0	0
2	0	0	875	643	548	793	2859
3	0	0	0	0	0	0	0
4	811	897	0	0	0	0	1708
SUM	811	897	875	643	548	793	4567
DEMAND	811	897	875	643	548	793	4567

TOTAL --> $ 37,083.52

Binary	Linking Constraints
0	0
1	-1708
0	0
1	-2859
2	

Possible Cost	Actual Cost
$ 2,224	$ -
$ 2,975	$ 2,975
$ 2,468	$ -
$ 2,008	$ 2,008

The optimal solution for this model is $37,083.52 when you minimize the objective.

Model with Stipulation

Please perform 2 out of the 3 scenarios below with a short text description on what changed:

1. *Instead of only being able to open 2 warehouses, what happens to our objective function when we only can open 1 warehouse?*

WH v DC >	1	2	3	4	5	6
1	25.71	6.93	36.47	30.06	39.97	23.81
2	22.91	22.63	6.91	2.12	10.41	10.25
3	20.46	12.5	39.12	36.11	37.3	33.42
4	11.68	7.1	24.4	21.39	25.94	18.7

WH v DC >	1	2	3	4	5	6	SUM
1	0	0	0	0	0	0	0
2	811	897	875	643	548	793	4567
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
SUM	811	897	875	643	548	793	4567
DEMAND	811	897	875	643	548	793	4567

TOTAL --> $ 60,121.46

Binary	Linking Constraints
0	0
1	0
0	0
0	0
1	

Possible Cost	Actual Cost
$ 2,224	$ -
$ 2,975	$ 2,975
$ 2,468	$ -
$ 2,008	$ -

You would change the objective function for the binary function to 1 instead of 2 and the total cost will increase instead of decrease.

2. *Right now, we have $1 per unit shipped over the distance between the warehouse and the DC. What happens to our objective function when we increase this to $30? Does your DC assignment change at all?*

WH v DC >	1	2	3	4	5	6	
1	771.3	207.9	1094.1	901.8	1199.1	714.3	
2	687.3	678.9	207.3	63.6	312.3	307.5	
3	613.8	375	1173.6	1083.3	1119	1002.6	
4	350.4	213	732	641.7	778.2	561	

WH v DC >	1	2	3	4	5	6	SUM
1	0	0	0	0	0	0	0
2	0	0	875	643	548	793	2859
3	0	0	0	0	0	0	0
4	811	897	0	0	0	0	1708
SUM	811	897	875	643	548	793	4567
DEMAND	811	897	875	643	548	793	4567
			TOTAL -->	$1,112,505.60			

Binary	Linking Constraints
0	0
1	-1708
0	0
1	-2859
2	

Possible Cost	Actual Cost
$ 2,224	$ -
$ 2,975	$ 2,975
$ 2,468	$ -
$ 2,008	$ 2,008

The prices for each DC would increase a lot causing the total to increase by a lot. This would be a very expensive solution and stipulation.

3. *For distance between each location, we used Manhattan distance but what happens to our model if we use Euclidean distance instead? Did the change impact the model at all? Do you feel this is a better distance metric to use in this scenario?*