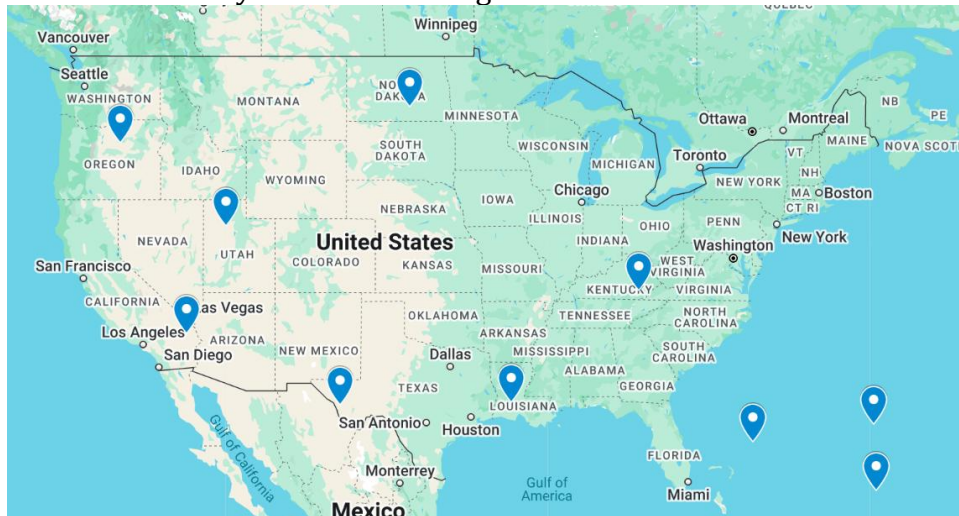


Module 09 – Fixed Charge Problem

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:

- *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



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.

Decision Variables:

X_i = The Amount of Products Sent from the Warehouses to the Distribution Centers

Objective Function:

$\text{MIN } 1485X_1 + 2092X_2 + 2187X_3 + 1421X_4$

Constraints:

Binary:

All Y_i must be binary

Linking Constraints:

$X_1 \leq M_1 Y_1$

$X_2 \leq M_2 Y_2$

$X_3 \leq M_3 Y_3$

$X_4 \leq M_4 Y_4$

Non-Negativity:

$X_i \geq 0 \quad i = 1, 2, 3, 4$

Model Optimized for Min Costs to Supply DCs

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

WH	DC	WH Lat	WH Long	DC Lat	DC Long	Manhattan
Ginger Snap Garden	Twizzler Tunnels	29.4	-67.31	44.88	-119.97	37.18
Ginger Snap Garden	Marzipan Metropolis	29.4	-67.31	30.51	-104.56	36.14
Ginger Snap Garden	Pudding Peaks	29.4	-67.31	37.15	-83.72	8.66
Ginger Snap Garden	Toblerone Tower	29.4	-67.31	28.28	-75.78	9.59
Ginger Snap Garden	Rainbow Sprinkle Summit	29.4	-67.31	40.62	-112.58	34.05
Ginger Snap Garden	Sugar Swirl Spires	29.4	-67.31	25.26	-67.19	4.26
Crispy Rice Reef	Twizzler Tunnels	30.69	-92.67	44.88	-119.97	13.11
Crispy Rice Reef	Marzipan Metropolis	30.69	-92.67	30.51	-104.56	12.07
Crispy Rice Reef	Pudding Peaks	30.69	-92.67	37.15	-83.72	2.49
Crispy Rice Reef	Toblerone Tower	30.69	-92.67	28.28	-75.78	19.3
Crispy Rice Reef	Rainbow Sprinkle Summit	30.69	-92.67	40.62	-112.58	9.98
Crispy Rice Reef	Sugar Swirl Spires	30.69	-92.67	25.26	-67.19	30.91
Cotton Candy Clouds	Twizzler Tunnels	34.73	-115.29	44.88	-119.97	5.47
Cotton Candy Clouds	Marzipan Metropolis	34.73	-115.29	30.51	-104.56	14.95
Cotton Candy Clouds	Pudding Peaks	34.73	-115.29	37.15	-83.72	29.15
Cotton Candy Clouds	Toblerone Tower	34.73	-115.29	28.28	-75.78	45.96
Cotton Candy Clouds	Rainbow Sprinkle Summit	34.73	-115.29	40.62	-112.58	3.18
Cotton Candy Clouds	Sugar Swirl Spires	34.73	-115.29	25.26	-67.19	57.57
Jolly Rancher Range	Twizzler Tunnels	46.69	-99.76	44.88	-119.97	22.02
Jolly Rancher Range	Marzipan Metropolis	46.69	-99.76	30.51	-104.56	20.98
Jolly Rancher Range	Pudding Peaks	46.69	-99.76	37.15	-83.72	25.58
Jolly Rancher Range	Toblerone Tower	46.69	-99.76	28.28	-75.78	42.39
Jolly Rancher Range	Rainbow Sprinkle Summit	46.69	-99.76	40.62	-112.58	18.89
Jolly Rancher Range	Sugar Swirl Spires	46.69	-99.76	25.26	-67.19	54

WH vs DC	Twizzler Tunnels	Marzipan Metropolis	Pudding Peaks	Toblerone Tower	Rainbow Sprinkle Summit	Sugar Swirl Spires	TC->	\$	116,069
Ginger Snap Garden	37.18	36.14	8.66	9.59	34.05	4.26			
Crispy Rice Reef	13.11	12.07	2.49	19.3	9.98	30.91			
Cotton Candy Clouds	5.47	14.95	29.15	45.96	3.18	57.57			
Jolly Rancher Range	22.02	20.98	25.58	42.39	18.89	54			
Total	77.78	84.14	65.88	117.24	66.1	146.74			

WH vs DC	Twizzler Tunnels	Marzipan Metropolis	Pudding Peaks	Toblerone Tower	Rainbow Sprinkle Summit	Sugar Swirl Spires	WH Sum Sent	Binary	Linking	Possible	Set Up Costs
Ginger Snap Garden	0	0	0	0	0	0	0	0	0	0	\$ 1,485
Crispy Rice Reef	0	0	0	0	0	0	0	0	0	0	\$ -
Cotton Candy Clouds	759	885	0	0	927	0	2571	1	-2318	\$ 2,187	\$ 2,187
Jolly Rancher Range	0	0	768	966	0	584	2318	1	-2571	\$ 1,421	\$ 1,421
Sum of Units Sent per DC	759	885	768	966	927	584	4889	2			
Total DC Demand with Sums	759	885	768	966	927	584	4889				

My model is recommending that to minimize costs, Fish and Murr Candy should open the warehouses Cotton Candy Clouds and Jolly Rancher Range, in order to minimize the total cost.

Model with Stipulation

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

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?
The total cost nearly doubles. Our company fulfills through just having the Crispy Rice Reef open.
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?
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?

Using Euclidean distance decreases the total cost. I feel that this metric is a better distance metric to use in this scenario because it measures I think it more accurately depicts the distance between the warehouses and distribution centers.

