WAREHOUSE SELECTION AND TRAVELLING SALESPERSON PROBLEM

It was a Monday morning and the newly appointed Operations Analyst expert had just arrived. He was recruited newly by a famous Internet shipping company "Shipkart Pvt.Ltd" and after completing the joining formalities, he sat down eagerly looking forward to his first real-time assignment and the demands of such a real-time project. Just then, he got a much awaited notification in his mail box and he opened it to see an email from his new project leader to meet him.

It was his first stint at analytics and he was looking forward to a challenging project that will help him bring to the table all the data crunching skills he acquired to be applied in a real-life scenario.

He entered the cabin and his mentor cleared his throat and said: "Welcome to Shipkart Analytics. You must be excited to know what you are here for. Ours is a first of a kind company that specializes in transporting packages from one city to another. We have been assigned a project, a very prestigious one.....we have got an project (Exhibit1) for analyzing and providing optimal location for a warehouse globally (one warehouse as well as more number of warehouse depend upon further analysis) keeping in mind the latitudinal and longitudinal constraints and ensuring that minimum distance is travelled for shipping the packets to that warehouse and hence minimum turnaround time to deliver the packets and minimum transportation

cost. The distance travelled is the straight line distance between two locations characterized by (Lat, Long) i.e., latitude and longitude respectively and measured by the distance formula: 69* [(Lat1-Lat2)^2 + (Long1-Long2)^2]^1/2.

Also, there is another project (which have 2 part)[Exhibit 2] from the point of view of the salesperson to devise a procedure such that a salesperson who lives in San Francisco wants to visit 10 other cities before returning home. In which order should he visit the cities to minimize the total distance he travels?

The Second part of above project suggest add few more (will discuss in due course of time) rule to sales person, for example sales person must visit New York after Denver? If sales person not follow the above said rules, then some penalty value for charged from the sales person (say 5000 $)! Now how sales person will make their strategy (follow the rules prescribed by the organization without penalty)!

The first project is due in 15 days' time and the second is deliverable after a month.

So, fire away!"

Thus, in the light of the above situation, the operation analyst was hired because of his number-crunching and analytical abilities and he had demonstrated working experience in handling similar operational issues in other companies and thus, was confronted with understanding the best warehouse locations and best route from point of view of a salesperson.

The analyst who was a specialist in Operation Analytics was also a reasonably good data cruncher and proceeded to first understand the dataset containing the different city locations in ordered pairs of (Latitude, Longitude) and the number of shipments to be delivered in Exhibit 1:

	City	Lat	Long	Shipments	Distance	Dist
7	New York	40.7	73.9	15		
8	Boston	42.3	71	8		
9	Philadelphia	40	75.1	10		
10	Charlotte	35.2	80.8	6		
11	Atlanta	33.8	84.4	11		
12	New Orleans	30	89.9	8		
13	Miami	25.8	80.2	13		
14	Dallas	32.8	96.8	10		
15	Houston	29.8	95.4	12		
16	Chicago	41.8	87.7	14		
17	Detroit	42.4	83.1	11		
18	Cleveland	41.5	81.7	8		
19	Indy	39.8	86.1	7		
20	Denver	39.8	105	8		
21	Minneapolis	45	93.3	9		
22	Phoenix	33.5	112	11		
23	Salt Lake City	40.8	112	10		
24	LA	34.1	118	18		
25	SF	37.8	123	12		

Exhibit 1: Sample of the dataset

The above data are explained in brief in the order in which they appear above: city, latitude, longitude and number of packets to be shipped. The total distance is to be minimized.

Similarly, the analyst also came across the dataset of cities to be covered by the salesperson visiting at least once as shown below in Exhibhit 2:

		Boston	Chicago	Dallas	Denver	LA	Miami	NY	Phoenix	Pittsburgh	SF	Seattle
1	Boston	0	983	1815	1991	3036	1539	213	2664	792	2385	2612
2	Chicago	983	0	1205	1050	2112	1390	840	1729	457	2212	2052
3	Dallas	1815	1205	0	801	1425	1332	1604	1027	1237	1765	2404
4	Denver	1991	1050	801	0	1174	1332	1780	836	1411	1765	1373
5	LA	3036	2112	1425	1174	0	2757	2825	398	2456	403	1909
6	Miami	1539	1390	1332	1332	2757	0	1258	2359	1250	3097	3389
7	NY	213	840	1604	1780	2825	1258	0	2442	386	3036	2900
8	Phoenix	2664	1729	1027	836	398	2359	2442	0	2073	800	1482
9	Pittsburgh	792	457	1237	1411	2456	1250	386	2073	0	2653	2517
10	SF	2385	2212	1765	1765	403	3097	3036	800	2653	0	817
11	Seattle	2612	2052	2404	1373	1909	3389	2900	1482	2517	817	0

Exhibit 2: Sample of the salesperson dataset

The data shows the distances of one city to another amongst the 10 proposed cities to visit.

So with the help of the above variables, the analyst can provide the optimal location for the single warehouse and an optimal route to salesperson to travel across all cities at least once and thus, provide recommendations.

Case questions:

Q1. What is the best location of the single warehouse to ship packets with minimum distance and how it is accomplished in which tool?

Q2. What is the best possible route for a salesperson to travel all the 10 cities at-least once and how it is accomplished in which tool?