HW 1: Facility Location

**ISE 453: Design of PLS Systems**   **Spring 2020**

Names: _____ Unity ID: _____ 14 Jan, due 23 Jan

You can submit both paper and a spreadsheet, two people per group, one submission per group.

1. A product will be produced at a single plant. Each ton of the product requires 2 tons of raw material A from a supplier located at site 5 on the figure below (corresponding to (x,y) coordinates (95,20)), 0.55 tons of raw material B from a supplier located at site 6, 1 ton of raw material C from a supplier located at site 7, and 0.35 tons of raw material D from a supplier located at site 8. The annual demand for the product for the four customers located sites 1–4 are 40, 38, 20, and 26 tons, respectively. The cost per ton-mile to ship the raw materials A, B, C, and D to the plant is $0.15, $0.05, $0.03, and $0.08, respectively, and the cost per ton-mile to ship the finished goods from the plant to the customers is $0.20. All scrap is disposed of locally. (a) Assuming rectilinear distance is a reasonable approximation of the actual travel distance in miles (so that you can solve it by hand, writing on the figure below), use the 2-D Median Location procedure to determine where the plant should be located in order to minimize transportation costs. (b) With respect to its monetary weight, is the product weight gaining or weight losing? Explain your answer.
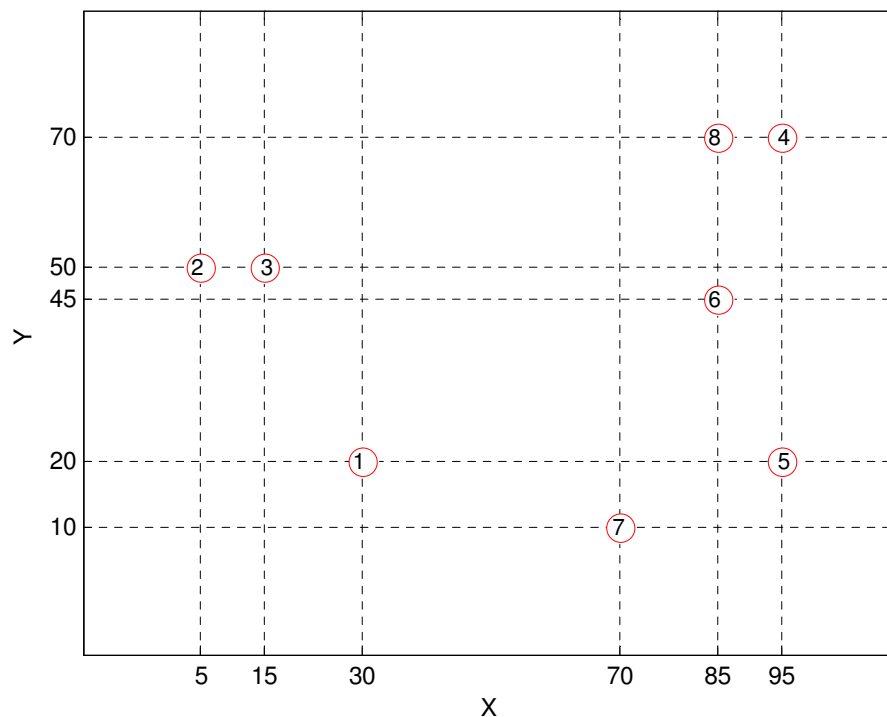
2. Assume that 48, 24, and 32 full truckloads (TL) per year of finished goods will be shipped to customers located in Detroit, MI, Gainesville, FL, and Memphis, TN, respectively.

(a) Where (longitude and latitude in decimal degrees) should a new factory be located in order to minimize total outbound truck travel? (Can use, e.g., *Google Maps* to get customer coordinates.)

(b) Determine near/in what city your factory should be located. (Can use, e.g., *Google Maps* to determine nearest city.)

(c) If the transportation rate is $2 per mile for each one-way TL shipment, what is the total transportation cost per year assuming that the trucks do not return to the factory and that the actual road distances are determined using *Google Maps*?

(d) Assuming that the factory will be built in Cary, NC instead of in the optimal *TC* city, what is the increase in total transportation cost per year?
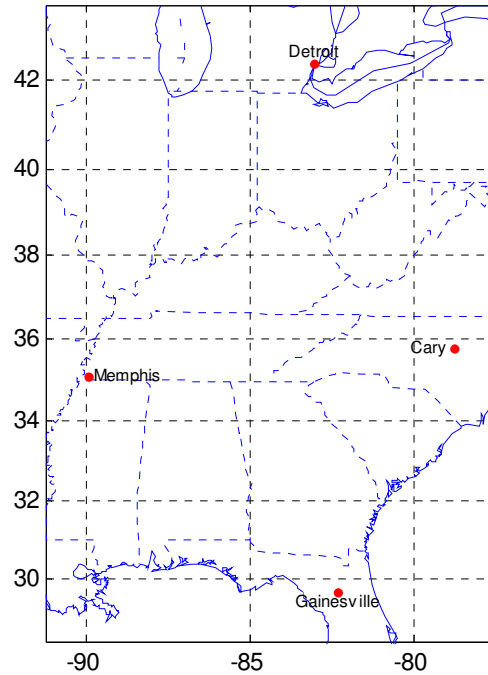
3. The 13 best retail warehouse locations in the U.S. are shown below. These locations minimize the total person-miles from the 877 3-digit-ZIP-code population centroids. The total population of the region surrounding each site and the distances (in miles) between sites are provided in the spreadsheet *RetailWarehouseSites.xlsx* (link on course webpage). (a) Considering these 13 locations as the available sites where a lesser number of warehouses can be located, use OpenSolver to determine the four best locations. The population of the sites not selected is assumed to travel to the closest warehouse location. (b) How can the single best location be determined without the need to use OpenSolver?