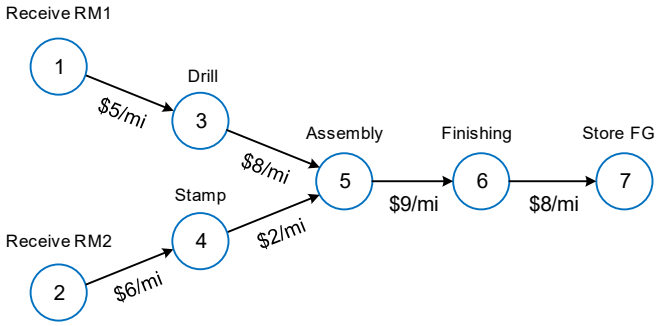
HW 4: Multifacility Location

ISE 754: Logistics Engineering **Fall 2019**

Assigned: Wed, 18 Sep (Groups of 2) Due: 11:30a, Wed, 25 Sep

Solve questions 2, 3, and 5(a) by hand (you can submit a scanned copy of your solution, or you can just turn in a paper copy in class) and then, for questions 1, 4, 5(b), and 6, create a script in Matlab that performs the calculations needed to answer each question, one cell for each part of each question. Please submit your script and either diary or "published" output file via Moodle.

1. Duplicate the results of Sections 17 and 18 of *Basic Concepts in Matlab*.



2. Two different raw materials are assembled to a finished good. Each RM is received at an existing location and the FG is stored at an existing location. Given the seven operations shown above, determine the locations, if any, for operations 3–6 that can be found using the Majority Theorem, where the monetary weights are shown for transport between operations.

3. Determine where to locate three different mixing steps in the production of a new liquid product. A facility in Nashville will bottle mixture 3, where each gallon of the mixture is produced by combining two gallons of raw material 4 and one gallon of mixture 2; mixture 2 is produced by combining three gallons of raw material 3 and one gallon of mixture 1; and mixture 1 is produced by combining two gallons of raw material 1 and one gallon of raw material 2. Raw materials 1–4 are produced in facilities in Gainesville, Roseville, Portland, and Greenville, respectively. All transportation between facilities will be in tanker trucks, which are only capacity limited with respect to the number of gallons that can be carried and not with respect to weight.

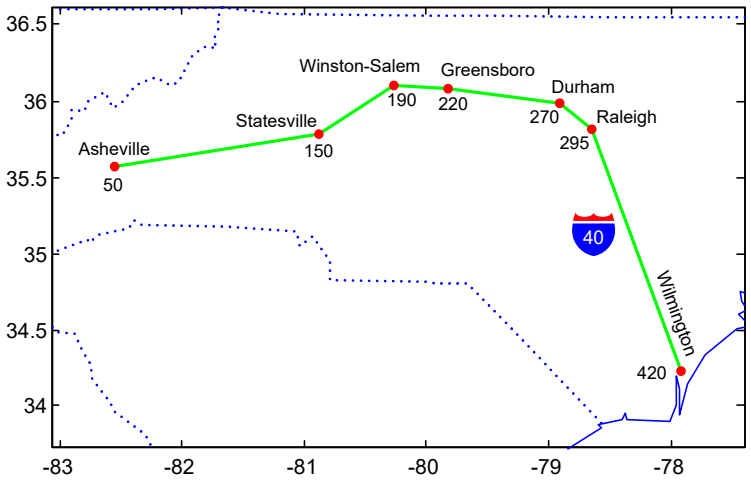
4. A widget factory receives widget subassemblies from Supplier 1 located in Gainesville, FL and widget cases from Supplier 2 located Warren, OH, and ships them to Customers 1–6 located at zip codes 10020, 17112, 27606, 32606, 48234, and 56123, respectively. Customers 1–6 have demands of 10, 40, 35, 15, 30, and 25 tons of widgets per year, respectively. 250 lb of cases, 1600 lb of subassemblies, and 300 lb of miscellaneous materials and supplies are used to produce each ton of widgets. The miscellaneous materials and supplies are sourced in small quantities from a large number of different suppliers and, as a result, can be ignored in this analysis. Trucks are used for transport between the suppliers and the factory and vans are used for transport between the factory and the customers. The transport rate for cases via truck is \$0.025 per ton-

mile, subassemblies via truck is $0.012 per ton-mile, widgets via truck is $0.04 per ton-mile, and widgets via van is $0.18 per ton-mile.

(a) Determine the nearest 50K city location of the widget factory that will minimize total transportation costs, assuming great circle distances.

(b) Determine the nearest 50K city locations of the widget factory and two DCs that will minimize total transportation costs. DC 1 serves Customers 1, 2, and 3 and DC 2 serves Customers 4, 5, and 6. Trucks are used for transport between the factory and the DCs.

(c) What is the percentage change in total cost associated with using DCs?



5. An EF is located in each city along I-40 in the figure above. Each EF has a demand equal to one P2P TL. Given starting locations of mile marker 60, 125 and 130

(a) Show, by hand, each step of the ALA procedure used to determine the NF locations.

(b) Use Matlog's *ALA* function to determine the optimal locations.

6. A chain of retail stores has a single DC located in Roanoke Rapids, NC that supplies all of its stores. One store is located in each city with a population of at least 10,000 in North Carolina, South Carolina, and Virginia, excluding those cities in Virginia that are located north of Charlottesville. Last year, the chain spent $6.7 million on outbound transportation costs. Each store's demand is proportional the population of the city that it is located in, and outbound transportation costs are proportional to demand-weighted distance.

(a) What would be the maximum expected reduction in annual outbound transportation costs if the DC could be re-located to any other location?

(b) What would be the maximum expected reduction in annual outbound transportation costs if two DCs could be located anywhere and the existing DC would be closed, where each store would be supplied by one of the DCs?

(c) What would be the change from (b) if only one new DC could be located anywhere and the existing DC in Rocky Mount remained open? (To solve this, you can create a user-defined function or handle for the *ALA* procedure that locates the one new DC and keeps the location of the existing DC fixed; the allocation procedure remains the same and you can use the default allocation in *ALA*.)