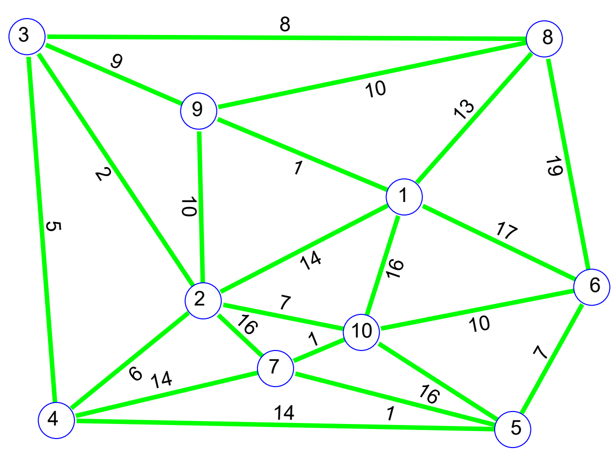
HW 7: Network Models

ISE 754: Logistics Engineering **Fall 2020**

Assigned: Wed, 15 Oct (Groups of 2) Due: 11:59p, Wed, 22 Oct

Solve question 2(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, 2(b), and 3–5, 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. Unless otherwise noted, each of the following questions builds upon the previous:
    a. Three DCs located in Zip codes 20548, 26149, and 36317 supply, in total, 40, 55, 35, 70, and 25 tons of a single product each year to customers located in Zip codes 30669, 38339, 30732, 23830, and 23154, respectively. Assuming that transport costs are proportional to great circle distance and that each DC can supply any amount of the product, determine the amount of product that should be supplied from each DC to each customer in order to minimize total ton-miles.
    b. What would be the change in total ton-miles if DCs are limited to supplying up to 60, 90, 80 tons per year of the product respectively, in total, to all of the customers?
    c. What would be the change in total ton-miles if the amount of the product that could be transported across each lane (i.e., each DC-to-customer transport link) could not exceed 30 tons per year?
    d. Plants located in Zip codes 28124, 27325, 37421, and 27513 can each produce up to 50 tons of the product. Assuming the DCs and lanes are unconstrained as in (a), determine the amount of product that should be supplied from each plant to each DC and from each DC to each customer in order to minimize total ton-miles.
2. The cost of each arc is shown in the network below. Use Dijkstra's algorithm to determine the least cost path from node 3 to node 6 (a) by hand and (b) via a script.



3. A professor wants to drive from his home in Raleigh (35:46:21 N, 78:42:05 W) to visit a colleague in the industrial engineering department at Georgia Tech (33:46:19 N, 84:23:24 W). Using the same travel speed assumptions as used in the example given in class (see "Example 4: Shortest Road Travel Time" in the Network Models 2 script), determine the shortest travel time for the trip and the distance of this trip. (You do not need to do provide the detailed sequence of the roads used or any plotting of the road network.)

4. A plant can use a three-stage process to produce two products. A 26-week rolling horizon is used for planning production. The products' forecasted demand, in tons, can be generated by executing the following commands: `T = 26, rng(1964),` `D = round([gamrnd(6,4,T,1) gamrnd(4,3,T,1)])`. The plant can produce up to 60, 55, and 50 and 50, 45, and 35 tons per week for each stage of each product, respectively; has production costs of $12, $75, and $35 and $20, $130, and $60 per ton for each stage of each product, respectively; and has costs of $400, $90, and $50 and $600, $110, and $60 per set up for each stage of each product, respectively. The annual inventory carrying rate is 0.4. The plant is currently set up to produce each stage of the first product and the first two week's demand of the second product is being held as finished product inventory. The final inventory for all stages of both products is zero. Determine the amount of each product that should be produced in order to minimize total costs over the planning horizon.

5. A single product is produced in a two-stage production process. Two identical machines are available for each stage. For stage one, each machine has a capacity of 20 tons per month and there is a fixed cost of $3000 per month if the machine is used for production that month and a variable cost of $200 for each ton of product produced. For stage two, each machine has a capacity of 30 tons per month and there is a fixed cost of $9000 and a variable cost of $800. The fixed costs are only incurred for each month a machine is used for production. Demand for the next six months is estimated to be 25, 15, 10, 50, 25, and 15 tons per month. Currently, five tons of material is in storage at stage one and none at stage two; at the end of the planning period, seven tons of material should be in storage at stage one and four at stage two. Up to 30 tons of material per month can be stored at each stage. Assuming that the product loses eight percent of its value after three months, determine the production plan that minimizes total costs over the planning horizon and what those total costs will be.