Name: Solution

ISyE 3101 Introduction to Supply Chain Modeling: Logistics

Fall 1999

Exam 2

November 17, 1999

Instructions

1. There are 4 pages.
2. Do your own work.
3. Show all calculations.
4. Give it your best shot!

Question 1

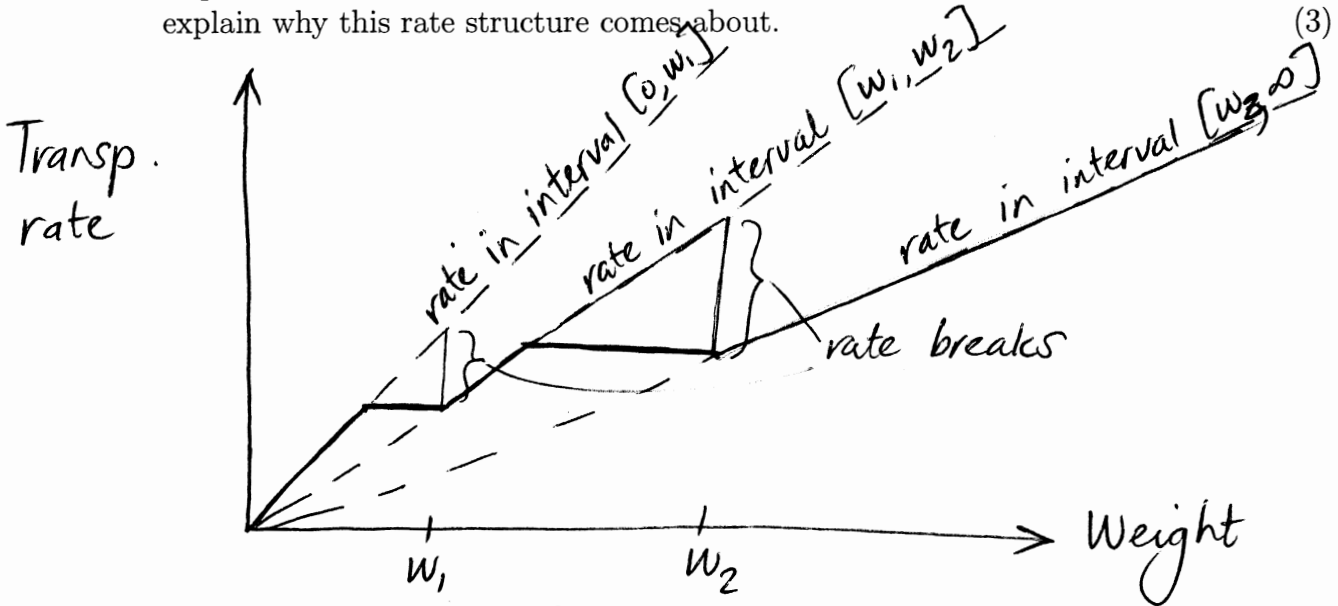
1.1 Name three ways in which the length of the order cycle can be reduced. (3)

1. Setting priorities for orders
2. Simultaneous processing of steps in order filling
3. Improving accuracy of orders
4. Increasing availability of items
5. Faster modes of transportation

1.2 What are the three most important factors carriers take into account when determining their freight rates for a shipment, as reflected in their rate tables? (3)

1. Distance
2. Quantity (Weight and/or Volume)
3. Type of product

1.3 Explain "blanket rates" in transportation. Draw a graph, clearly label the axes, and explain why this rate structure comes about. (3)



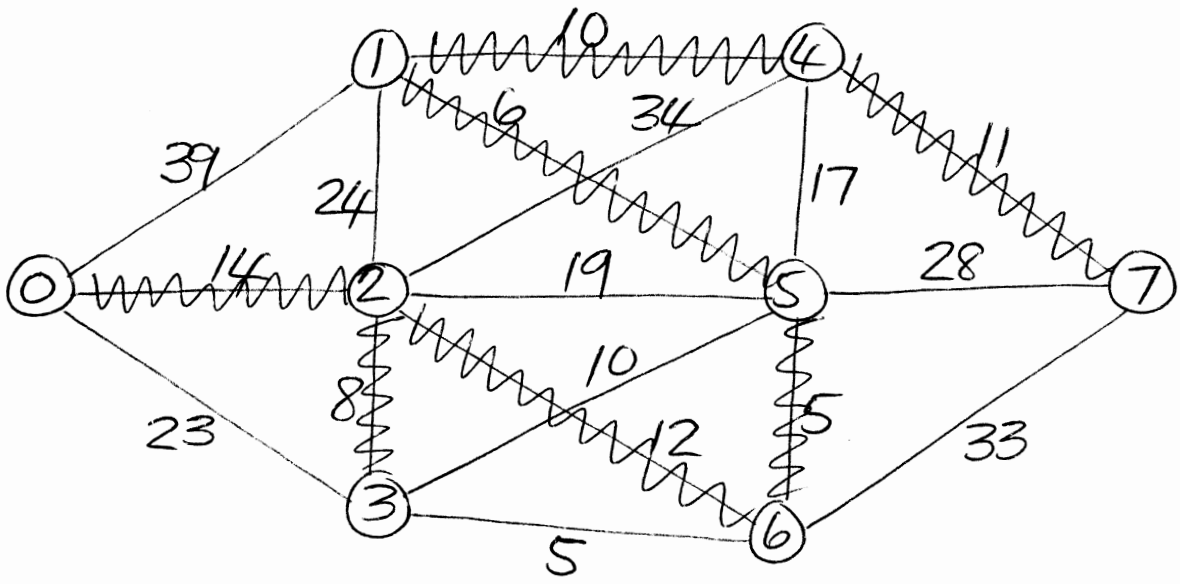
Carriers use different rates for different intervals, at the boundaries of the intervals occur "rate breaks". To make the rates increasing in weight, the curve is leveled off at the breaks.

1.4 Name and describe 3 terminal services provided by for-hire carriers. (6)

1. Pick-up and delivery
2. Switching:- rail carriers pick up / drop off railcars on shippers' private sidings
3. Demurrage & detention:- containers / trailers / railcars can be kept by shippers / receivers for loading / unloading. (detention) If amount of time kept exceeds a threshold, penalties are imposed (demurrage).

Question 2

Use Dijkstra's algorithm to determine the shortest path from node 0 to all other nodes in the network. Show your calculations in the given table, and give the final shortest distances and shortest path predecessors for all nodes in the final 2 rows of the table. Draw the shortest path tree from node 0 to all other nodes on the given network. (15)



Distance and Predecessor Labels:

	Node 0	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7
Step 0	0 (-)	∞	∞	∞	∞	∞	∞	∞
Step 1		39 (0)	14 (0)	23 (0)	∞	∞	∞	∞
Step 2		38 (2)		22 (2)	48 (2)	33 (2)	26 (2)	∞
Step 3		38 (2)			48 (2)	32 (3)	26 (2)	∞
Step 4		38 (2)			48 (2)	31 (6)		59 (6)
Step 5		37 (5)			48 (2)			59 (6)
Step 6					47 (1)			59 (6)
Step 7								58 (4)
Optimal Distances	0	37	14	22	47	31	26	58
(Optimal Predecessors)	–	5	0	2	1	6	2	4

Question 3

Loads are to be transported from the distribution center at node 0 to customers at the other nodes of the network. The sizes of the loads to be delivered at the customers are as indicated next to the nodes in the following network. The capacity of our vehicle is 200 units. We want to find a set of vehicle routes that visits each customer once and delivers the appropriate loads, such that the loads delivered on any route do not exceed the vehicle capacity, and the total of all route lengths is minimized.

3.1 Solve a Bin Packing Problem to estimate the number of vehicles needed to make the deliveries. Use the First-Fit Decreasing heuristic. (10)

item/load size: 90 85 75 70 65 60 60 50 45 35 30 30
customer/node #: 8 12 3 1 15 6 11 5 14 2 4 10

25 20 20
7 9 13

Items/loads in bin 1: 8, 12, 7
Items/loads in bin 2: 3, 1, 5
Items/loads in bin 3: 15, 6, 11
Items/loads in bin 4: 14, 2, 4, 10, 9, 13

Number of vehicles needed = 4.

3.2 Use a "route-first cluster-second" heuristic to find a good set of vehicle routes. First use the nearest neighbor heuristic to find a tour through all the nodes in the network that attempts to minimize the total tour length. *Number the arcs in the sequence that you choose them in constructing the tour.* Then construct the individual vehicle routes. Draw your vehicle routes on the given network. What is the total length of all the vehicle routes? (10)