Sheet 6-Chapter 6 PROBLEMS

Distribution and Network Models

1. A company imports goods at two ports: Philadelphia and New Orleans. Shipments of one product are made to customers in Atlanta, Dallas, Columbus, and Boston. For the next planning period, the supplies at each port, customer demands, and shipping costs per case from each port to each customer are as follows:

<table>
<thead>
<tr>
<th>Port</th>
<th>Atlanta</th>
<th>Dallas</th>
<th>Columbus</th>
<th>Boston</th>
<th>Port Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philadelphia</td>
<td></td>
<td>2</td>
<td>6</td>
<td></td>
<td>5000</td>
</tr>
<tr>
<td>New Orleans</td>
<td>1</td>
<td></td>
<td>6</td>
<td>5</td>
<td>3000</td>
</tr>
<tr>
<td>Demand</td>
<td>1400</td>
<td>3200</td>
<td>2000</td>
<td>1400</td>
<td></td>
</tr>
</tbody>
</table>

Develop a network representation of the distribution system (transportation problem).

2. Consider the following network representation of a transportation problem:

The supplies, demands, and transportation costs per unit are shown on the network.

   a. Develop a linear programming model for this problem; be sure to define the variables in your model.
   b. Solve the linear program to determine the optimal solution.
23. Find the shortest route from node 1 to node 7 in the network shown.

24. In the original Gorman Construction Company problem, we found the shortest distance from the office (node 1) to the construction site located at node 6. Because some of the roads are highways and others are city streets, the shortest-distance routes between the office and the construction site may not necessarily provide the quickest or shortest-time route. Shown here is the Gorman road network with travel time rather than distance. Find the shortest route from Gorman’s office to the construction site at node 6 if the objective is to minimize travel time rather than distance.

26. Morgan Trucking Company operates a special pickup and delivery service between Chicago and six other cities located in a four-state area. When Morgan receives a request for service, it dispatches a truck from Chicago to the city requesting service as soon as possible. With both fast service and minimum travel costs as objectives for Morgan, it is important that the dispatched truck take the shortest route from Chicago to the specified city. Assume that the following network (not drawn to scale) with distances given in miles represents the highway network for this problem. Find the shortest-route distance from Chicago to node 6.
27. City Cab Company identified 10 primary pickup and drop locations for cab riders in New York City. In an effort to minimize travel time and improve customer service and the utilization of the company’s fleet of cabs, management would like the cab drivers to take the shortest route between locations whenever possible. Using the following network of roads and streets, what is the route a driver beginning at location 1 should take to reach location 10? The travel times in minutes are shown on the arcs of the network. Note that there are two one-way streets with the direction shown by the arrows.

29. The north–south highway system passing through Albany, New York, can accommodate the capacities shown:

Can the highway system accommodate a north–south flow of 10,000 vehicles per hour?
30. If the Albany highway system described in Problem 29 has revised flow capacities as shown in the following network, what is the maximal flow in vehicles per hour through the system? How many vehicles per hour must travel over each road (arc) to obtain this maximal flow?

![Network Diagram]

31. A long-distance telephone company uses a fiber-optic network to transmit phone calls and other information between locations. Calls are carried through cable lines and switching nodes. A portion of the company’s transmission network is shown here. The numbers above each arc show the capacity in thousands of messages that can be transmitted over that branch of the network.

![Network Diagram]

To keep up with the volume of information transmitted between origin and destination points, use the network to determine the maximum number of messages that may be sent from a city located at node 1 to a city located at node 7.