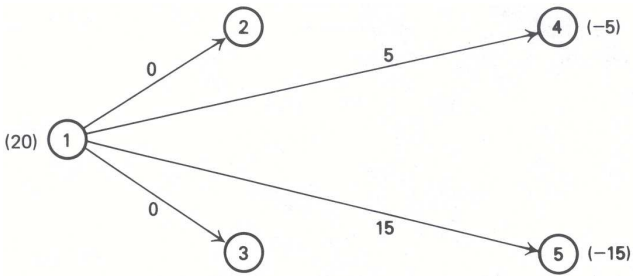


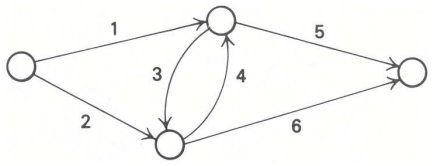
Figure 8.23 Artificial initial basis.

EXERCISES

1. A gas company owns a pipeline network, sections of which are used to pump natural gas from its main field to its distribution center. The network is shown below, where the direction of the arrows indicates the only direction in which the gas can be pumped. The pipeline links of the system are numbered one through six, and the intermediate nodes are large pumping stations. At the present time, the company nets 1200 mcf (million cubic feet) of gas per month from its main field and must transport that entire amount to the distribution center. The following are the maximum usage rates and costs associated with each link:

	1	*2*	*3*	*4*	*5*	*6*
Maximum usage: mcf/month	500	900	700	400	600	1000
Tariff: $/mcf	20	25	10	15	20	40

The gas company wants to find those usage rates that minimize total cost of transportation.



a) What are the decision variables?
b) Formulate the problem as a linear program.
c) For the optimal solution, do you expect the dual variable associated with the maximum usage of link 1 to be positive, zero, or negative and why?
d) Suppose there were maximum usage rates on the pumping stations; how would your formulation change?

2. On a particular day during the tourist season a rent-a-car company must supply cars to four destinations according to the following schedule:

Destination	*Cars required*
A	2
B	3
C	5
D	7

The company has three branches from which the cars may be supplied. On the day in question, the inventory status of each of the branches was as follows:

Branch	*Cars available*
1	6
2	1
3	10

The distances between branches and destinations are given by the following table:

	Destination			
Branch	A	B	C	D
1	7	11	3	2
2	1	6	0	1
3	9	15	8	5

Plan the day's activity such that supply requirements are met at a minimum cost (assumed proportional to car-miles travelled).

3. The National Association of Securities Dealers Automated Quotation Systems (NASDAQ) is a network system in which quotation information in over-the-counter operations is collected. Users of the system can receive, in a matter of seconds, buy and sell prices and the exact bid and ask price of each market maker that deals in a particular security. There are 1700 terminals in 1000 locations in almost 400 cities. The central processing center is in Trumbull, Conn., with concentration facilities in New York, Atlanta, Chicago, and San Francisco. On this particular day, the market is quiet, so there are only a few terminals being used. The information they have has to be sent to one of the main processing facilities. The following table gives terminals (supply centers), processing facilities (demand centers), and the time that it takes to transfer a message.

Terminals	Trumbull	N.Y.	Atlanta	Chicago	San Fran.	*Supply*
Cleveland	6	6	9	4	10	45
Boston	3	2	7	5	12	90
Houston	8	7	5	6	4	95
Los Angeles	11	12	9	5	2	75
Washington,D.C.	4	3	4	5	11	105
Demand	120	80	50	75	85	

a) Solve, using the minimum matrix method to find an initial feasible solution.
b) Are there alternative optimal solutions?

4. A large retail sporting-goods chain desires to purchase 300, 200, 150, 500, and 400 tennis racquets of five different types. Inquiries are received from four manufacturers who will supply not more than the following quantities (all five types of racquets combined).

M1 600
M2 500
M3 300
M4 400

The store estimates that its profit per racquet will vary with the manufacturer as shown below:

	Racquets				
Manufacturer	R1	R2	R3	R4	R5
M1	5.50	7.00	8.50	4.50	3.00
M2	6.00	6.50	9.00	3.50	2.00
M3	5.00	7.00	9.50	4.00	2.50
M4	6.50	5.50	8.00	5.00	3.50