Lecture 5 & 6 Network Modeling

1. Draw the network representation of the following network flow problem.

MIN: $5X_{12} + 3X_{13} + 2X_{14} + 3X_{24} + 2X_{34}$

Subject to:

$-X_{12} - X_{13} - X_{14} = -10$

$X_{12} - X_{24} = 2$

$X_{13} - X_{34} = 3$

$X_{14} + X_{24} + X_{34} = 5$

$X_{ij} \geq 0$ for all i and j

2. A company needs to ship 100 units from ROA to WAS at the lowest possible cost. The costs associated with shipping between the cities are:

	To		
From	LEX	WAS	CHA
ROA	50	-	80
LEX	-	50	40
CHA	-	30	

Draw the network representation of this problem.

3. A company needs to ship 100 units from Sydney to Adelaide at the lowest possible cost. The costs associated with shipping between the cities are listed below. Also, the decision variable associated with each pair of cities is shown next to the cost.

		To		
From	Melbourne	Darwin	Perth	Adelaide
Sydney	100 (X_{12})	500 (X_{13})	600 (X_{14})	-
Melbourne	-	350 (X_{23})	300 (X_{24})	-
Darwin	-	-	250 (X_{34})	200 (X_{35})
Perth	-	-	-	200 (X_{45})

Write out the LP formulation for this problem.

4. A manufacturing company has a pool of 50 labor hours. A customer has requested two products, Product A and Product B, and has requested 15 and 20 of each respectively. It requires 2 hours of labor to produce Product A and 3 hours of labor to produce Product B. The company can obtain up to 50 additional hours of labor if required. In-house labor costs $25 per hour while contracted labor costs $45 per hour. Draw the network flow model that captures this problem.

5. Write out the LP formulation for the problem in Question 4.

6. Carlton Distributing has three plants and four distribution centers. The plants, their supply, the distribution centers, their demands, and the distance between each location is summarized in the following table:

Distance	Center 1	Center 2	Center 3	Center 4	Supply
Plant A	45	60	53	75	500
Plant B	81	27	49	62	700
Plant C	55	40	35	60	650
Demand	350	325	400	375	

Draw the (balanced) transportation network for Carlton's distribution problem.

7. Formulate the LP for Carlton (in Question 6) assuming they wish to minimize the total product-miles incurred.

8. Draw the network representation of this LP model. What type of problem is it?

MAX X_{41}

Subject to: $X_{41} - X_{12} - X_{13} = 0$

$X_{12} - X_{24} = 0$

$X_{13} - X_{34} = 0$

$X_{24} + X_{34} - X41 = 0$

$0 \le X_{12} \le 5,$

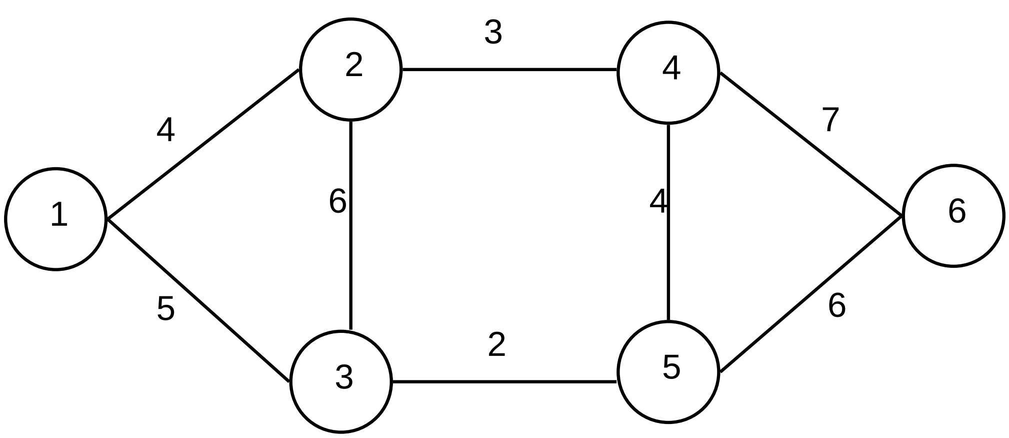
$0 \le X_{13} \le 4,$

$0 \le X_{24} \le 3,$

$0 \le X_{34} \le 2,$

$0 \le X_{41} \le \infty$

9. Solve the following minimal spanning tree problem starting at node 1.



10. Consider the following distribution problem for Ace Widgets:

	Shipping Costs to Warehouses				
Plants	**W1**	**W2**	**W3**	**W4**	**Capacity**
P1	2	6	4	12	100
P2	7	3	10	11	250
P3	5	8	9	13	300
Demand	50	150	200	250	

a) Apply the North-west corner method to determine a starting solution. Compute the total cost.

b) Using the solution obtained in part (a), determine the new shipping schedule according to the closed-loop path (MODI method). Compute the total cost.

c) Draw a network diagram to depict Ace Widgets Shipping Distribution.

d) Formulate an LP formulation for Ace Widgets.

11. The following is a distribution schedule for Ace Widgets warehouses and customers in the Western region:

	Shipping Costs to Customers			
Warehouse	**C1**	**C2**	**C3**	**Capacity**
W1	7	2	8	30
W2	5	3	1	50
W3	4	6	7	40
Demand	60	40	20	

e) Using the Vogel's Approximation Method (VAM) determine a starting solution for this problem. Compute the total cost.

f) Using the solution obtained in part (a), determine the new shipping schedule according to the closed-loop path (MODI method). Compute the total cost.

g) Draw a network diagram to depict Ace Widgets Distribution in the Western region.

h) Formulate an LP for this problem.