Lecture 5 & 6 Review Question (Solution):

<u>Question 10</u>

Consider the following distribution problem for Ace Widgets:

Depot	Shipping Costs to Warehouses 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.

		K1=	K2=	K3=	K4=	K5=	
	Source	Destination W1	W2	W3	W4		SUPPLY
R1=	P1	2 *50*	6 *50*	4	12		~~100~~ 50
R2=	P2	7	3 *100*	10 *150*	11		~~250~~ 150
R3=	P3	5	8	9 *50*	13 *250*		~~300~~
R4=							
	DEMAND	50	~~150~~ 100	~~200~~ 50	~~250~~		

Total cost = 2 x 50 + 6 x 50 + 3 x 100 + 10 x 150 + 9 x 50 + 13 x 250 = $5,900

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.

MODI: 1st Iteration

		K1= 2	K2= 6	K3= 13	K4= 17	K5=	
	Source	Destination W1	W2	W3	W4		SUPPLY
R1= 0	P1	2 *50*	6 -	4 + *50* -9	12 -5		100
R2= -3	P2	7 8	3 + *150*	10 - *100*	11 -3		250
R3= -4	P3	5 7	8 6	9 *50*	13 *250*		300
R4=							
	DEMAND	50	150	200	250		

MODI: 2nd Iteration

		K1= 2	K2= -3	K3= 4	K4= 8	K5=	
	Source	Destination W1	W2	W3	W4	D5	SUPPLY
R1= 0	P1	2 50	6	4 50	12 4		100
R2= 6	P2	7 -1	3 150	10 - 	11 + 100 -3		250
R3= 5	P3	5 -2	8 6	9 + 150	13 - 150		300
R4=							
	DEMAND	50	150	200	250		

MODI: 3rd Iteration

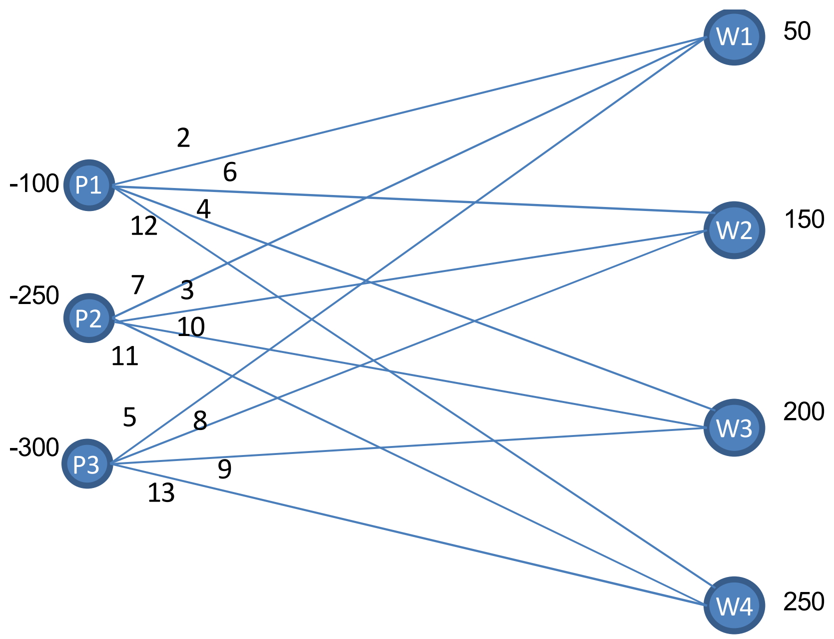
		K1= 2	K2= 0	K3= 4	K4= 8	K5=	
	Source	Destination W1	W2	W3	W4		SUPPLY
R1= 0	P1	2 - ~~50~~	6 6	4 + 50 +50	12 4		100
R2= 3	P2	7 2	3 150	10 3	11 100		250
R3= 5	P3	5 + +50 -2	8 3	9 - ~~150~~ 100	13 150		300
R4=							
	DEMAND	50	150	200	250		

MODI: Final

		K1= 0	K2= 0	K3= 4	K4= 8	K5=	
	Source	Destination W1	W2	W3	W4		SUPPLY
R1= 0	P1	2 2	6 6	4 100	12 4		100
R2= 3	P2	7 4	3 150	10 3	11 100		250
R3= 5	P3	5 50	8 3	9 100	13 150		300
R4=							
	DEMAND	50	150	200	250		

Total cost = 4 x 100 + 3 x 150 + 11 x 100 + 5 x 50 + 9 x 100 + 13 x 150 = $5,050

c) Draw a network model to depict this problem.



d) Formulate an LP formulation for Ace Widgets.

ANSWER:

Let X_{ij} be the trip from Depot (i) to Warehouse (j); where i = P1, P2, P3 and j = W1, W2, W3, W4

C_{ij} be the cost from Depot (i) to Warehouse (j)

MIN: $\sum C_{ij}X_{ij}$

ST: $X_{11} + X_{12} + X_{13} + X_{14} = 100$ (or you can write $\sum X_{1j} = 100$)

$\sum X_{2j} = 250$

$\sum X_{3j} = 300$

$\sum X_{i1} = 50$

$\sum X_{i2} = 150$

$\sum X_{i3} = 200$

$\sum X_{i4} = 250$

Question 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	50
Demand	60	40	20	

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

Note: As Capacity (Supply) > Demand, you need to add a dummy column (for demand)

		K1=	K2=	K3=	K4=	K5=		
				Destination				
	Source	C1	C2	C3	Dummy		SUPPLY	O/L
R1=	W1	7	2 30	8			30	7-2 = 5
R2=	W2	5 10	3 10	1 20	10		50	3-1 = 2 5-3 = 2
R3=	W3	4 50	6	7			50	6-4 = 2
R4=								
	DEMAND	60	40	20	10		130 130	
O/L		5-4 = 1	3-2 = 1 6-3 = 3	7-1 = 6				

Total cost = 2 x 30 + 5 x 10 + 3 x 10 + 1 x 20 + 4 x 50 = $360

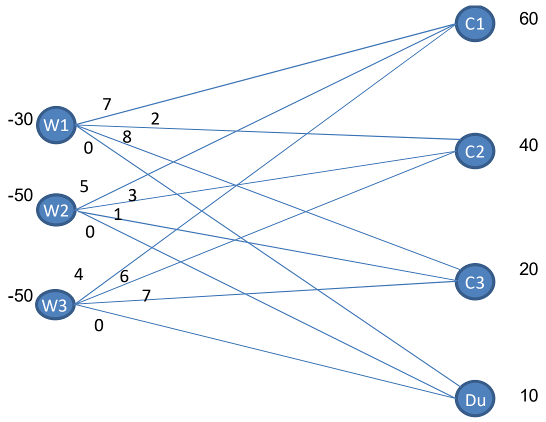
b) Using the solution obtained in part (a), determine the new shipping schedule according to the closed-loop path (MODI method). Compute the total cost.

MODI: 1st Iteration

		K1= 4	K2= 2	K3= 0	K4= -1	K5=	
				Destination			
	Source	C1	C2	C3	Dummy		SUPPLY
R1= 0	W1	7 3	2 30	8 8	0 1		30
R2= 1	W2	5 10	3 10	1 20	0 10		50
R3= 0	W3	4 50	6 4	7 7	0 1		50
R4=							
	DEMAND	60	40	20	10		

As there are no negative Cij – (Ri + Kj) values, the solution is already optimal. So, it is the same as the VAM technique: Total cost = 2 x 30 + 5 x 10 + 3 x 10 + 1 x 20 + 4 x 50 = $360

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



d) Formulate an LP for this problem.

ANSWER:

Let X_{ij} be the trip from Warehouse (i) to Customers (j); where i = W1, W2, W3 and j = C1, C2, C3, C4

C_{ij} be the cost from Warehouse (i) to Customers (j)

MIN: $\sum C_{ij}X_{ij}$

ST: $X_{11} + X_{12} + X_{13} + X_{14} = 30$ (or you can write $\sum X_{1j} = 30$)

$\sum X_{2j} = 50$

$\sum X_{3j} = 50$

$\sum X_{i1} = 60$

$\sum X_{i2} = 40$

$\sum X_{i3} = 20$

$\sum X_{i4} = 10$ (this is dummy demand)