

Question 16

The state of Missouri has three power generating companies (A, B, C). During the months of peak demand, the Missouri Power Authority authorizes these companies to pool their excess supply and to distribute it to smaller independent power companies that do not have generators large enough to handle the demand. Excess supply is distributed on the basis of cost per kilowatt hour transmitted. The following table shows the demand and supply in millions of kilowatt hours and the cost per kilowatt hour of transmitting electric power to four small companies in cities W, X, Y and Z.

	w	x	Y	Z	Excess Supply
A	12	4	9	5	55
B	8	1	6	6	45
C	1	12	4	7	30
Unfilled Power Demand	40	20	50	20	

Use VAM to find initial transmission assignment of the excess power supply. Then apply the MODI technique to find the least cost distribution system.

Question 17

Consider the following optimal tableau where S1 and S2 are slack variable added to the original problem:

C_j		10	30	0	0	
Solution Basic	X_1	X_2	S_1	S_2	quantity	
X_1	1	4	2	0	160	
S_2	0	6	-7	1	200	
Z_j	10	40	20	0	1600	
$C_j - Z_j$	0	-10	-20	0		

a) What is the range of optimality for the contribution rate of the variable X_1 ?

- b) What is the range of insignificance of the contribution rate of the variable X_2 ?
- c) How much would you be willing to pay for one more unit of the first resource, which is represented by slack variable S_1 ?
- d) What is the value of one more unit of the second resource? Why?
- e) What would the optimal solution be if the profit on X_2 were changed to 35 instead of 30?
- f) What would the optimal solution be if the profit on X_1 were changed to 2 instead of 10? How much would the maximum profit change?
- g) How much could the right hand side in constraint 2 be decreased before profit would be affected?

Question 18

A linear program has been formulated and solved. The optimal simplex tableau for this is given at the bottom of this page.

- a. What are the shadow prices for the three constraints? What does a zero shadow price mean? How can this occur?
- b. How much could the right hand side of the first constraint be changed without changing the solution mix?
- c. How much could the right hand side of the third constraint be changed without changing the solution mix?

Optimal tableau

C_j	80	120	90	0	0	0	
Solution Basic	X_1	X_2	X_3	S_1	S_2	S_3	quantity
X_2	-1.5	1	0	0.125	-0.75	0	37.5
X_3	3.5	0	1	-0.125	1.25	0	12.5
S_3	-1	0	0	0	-0.5	1	10
Z_j	135	120	90	3.75	22.5	0	5625
$C_j - Z_j$	-55	0	0	-3.75	-22.5	0	

Question 19

The International City Trust (ICT) invests in short term trade credits, corporate bonds, gold stocks and construction loans. To encourage a diversified portfolio, the board of directors has placed limits on the amount that can be committed to any one type of investment. ICT has \$5 million available for immediate investment and wishes to do two things: (1) maximize the diversification requirements as set by the board of directors.

The specifics of the investment possibilities are as follows:

Interest investment	earned (%)	Max. Investment (millions)
Trade credit	7	1
Corporate bonds	11	2.5
Gold stocks	19	1.5
Construction loans	1	1.8

In addition, the board specifies that at least 55% of the funds invested must be in gold stocks and investment decision as an LP problem.

Question 20

The following table shows all the necessary information on the available supply to each warehouse, the requirement of each market and the unit transportation cost in rupees from each warehouse to each market.

	Market				supply
	1	2	3	4	
A	5	2	4	3	22
B	4	8	1	6	15
C	4	6	7	5	8
Requirement	7	12	17	9	

The shipping clerk has worked out the following schedule from experience:

12 units from A to 2, 1 unit from A to 3, 9 units from A to 4, 15 units from B to 3, 7 units from C to 1 and from C to 3.

- a. Check and see if the clerk has made the optimal schedule
- b. Find optimal schedule and minimum total shipping cost.
- c. If the clerk is approached by how much must the rate be reduced before the clerk should consider giving him an order?

Question 21

Solve the following LPP by the simplex method.

$$\min Z = 3x_1 + 4x_2 + 5x_3$$

$$2x_1 + x_2 + 2x_3 \geq 30$$

$$2x_1 + 3x_2 + x_3 \leq 36$$

$$2x_1 + x_2 + x_3 \geq 35$$

$$x_1, x_2, x_3 \geq 0.$$

- a. Identify the basic and non basic and basic variables in the solution.
- b. What are the base row coefficients of non basic variable?
- c. How are they useful for sensitivity analysis by 5 each of the resources.

Question 22

The Low Knock Oil Company produces two grades of cut rate gasoline for industrial distribution. The grades, regular and economy are produced by refining a blend of two types of crude oil, type X 100 and type X220. Each crude oil differs not only in cost per barrel but in composition as well. The following table indicates the percentage of crucial ingredients found in each of the crude oils and cost per barrel for each.

Oil Type	ingredient a (%)	ingredient b (%)	Cost / barrel (s0
X100	35	55	30.00
X220	60	25	34.80

Weekly demand for the regular grade of Low Knock gasoline is at least 25,000 barrels and demand for the economy is at least 32,000 barrels per week. At least 45% of each barrel of regular must be ingredient A. At most 50% of each barrel of economy should contain ingredient B.

The Low Knock management must decide how many barrels of each type of crude oil to buy each week for blending to satisfy demand at minimum cost. Solve this as an LP problem.

Question 23

A company has at A, B, and C which supply warehouse at D, E, F and G. Monthly factors capacities are 250, 300 and 400 units respectively for regular production. If overtime production is utilized, factories A and B can produce 50 and 75 additional units respectively at overtime incremental costs of Rs.4 and Rs.5 respectively. Unit transport costs in rupees from factories to warehouse are as follows;

	D	E	F	G
A	11	13	17	14
B	16	18	14	10
C	21	24	13	10

Determine the optimum distribution for this company to minimize costs.

Question 24

A transport company engages in carrying schedule most profitable to the company distance(km) from each branch to each of the customers is given below,

	Branches					No. of trucks available
	A	B	C	D	E	

1	10	8	12	9	3	15
2	4	4	6	6	7	12
3	15	7	11	13	8	16
No. of trucks required	8	8	4	7	6	

- i. Find out VAM the allocation of trucks from branches to customers in order to min. the total cost of transportation assuming that the cost is proportional to distance. What is the min. required distance to be run by the trucks?
- ii. If an arrival of V.V.i.P. blocks the traffic from branch I to Customers c and from branch 2 to customer D and E, what should be the optimal allocation in order to min. the total transportation cost?

Question 25

A company manufactures three products P1,P2 and P3 which yield per unit profit of Rs.200, Rs.400 and Rs. 300 respectively. Each of these products is processed on three different machines. The time required on each machine per unit of the product is given below. How many products of each type should be produced to maximize the profit?

Product	Time required(hours /unit)		
	Machine 1	Machine 2	Machine 3
P1	30	20	10
P2	40	10	30
P3	20	20	20
Time available(hours)	600	400	800

