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Quantitative Management Modeling

Assignment
Module 6

THE TRANSPORTATION MODEL

Given : Plants A and B

	UNIT SHIPPING COST			COST	
	W1	W2	W3	UNIT Production	MONTHLY Production
Plant A	\$22	\$14	\$30	\$600	100
Plant B	\$16	\$20	\$24	\$625	120
Monthly Demand	80	60	70		

Here, total supply > total demand
220 > 210

→ We could make a parameter table to formulate this problem

COST PER UNIT DISTRIBUTED

		1	2	3	4	SUPPLY
Plant	A	622	614	630	0	100
	B	641	645	649	0	120
Demand		80	60	70	10	

→ Now let's form the decision variables —

X_{pw} ⇒ Represents the number of AEDs shipped from plant (p) to warehouse (w)

∴ (P = A, B) and (W = 1,2,3)

The objective function is —

$$Z = 622(X_{A1}) + 614(X_{A2}) + 630(X_{A3}) + 641(X_{B1}) + 645(X_{B2}) + 649(X_{B3})$$

And the constraints are —

$$X_{A1} + X_{A2} + X_{A3} <= 100$$
$$X_{B1} + X_{B2} + X_{B3} <= 120$$
$$X_{A1} + X_{B1} = 80$$
$$X_{A2} + X_{B2} = 60$$
$$X_{A3} + X_{B3} = 70$$
$$X_{pw} \geq 0$$

When demand ≠ supply, we create dummy variables

demand < supply : dummy column
demand > supply : dummy row

2 For transportation cost minimization

$$VA = P_i^d - P_i^0$$

$$\text{Max } VA = (80p^d_1 + 60p^d_2 + 70p^d_3) - (100\,p^o_1 - 120\,p^o_2)$$

For Plant A

$$p^d_1 - p^o_1 \geq 22$$

$$p^d_2 - p^o_1 \geq 14$$

$$p^d_3 - p^o_1 \geq 30$$

Plant B

$$p^d_1 - p^o_2 \geq 16$$

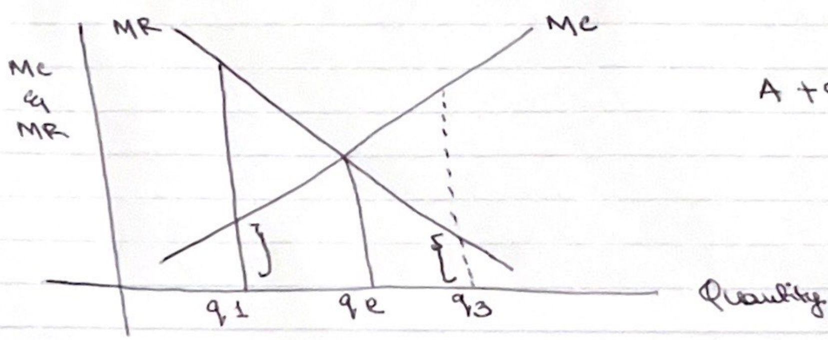
$$p^d_2 - p^o_2 \geq 20$$

$$p^d_3 - p^o_2 \geq 24$$

Say for all the non-negative variables we need $p^p_w \geq 0$
$w = 1, 2, 3$

EXAMPLE

For maximizing VA : If MR > MC, the production will increase



At q_1 : MR > MC

(3) The economic interpretation of the dual problem is there is no solution. Here, we see that the shadow price is primal. The dual solution of this transportation model indicates that all the prices for the primal problem is 0. This says there might be no scope of increasing the cost or decreasing the cost even after allocating resources in all the plants (A & B). Therefore, the feasible solution is that the marginal cost must be equal to the marginal revenue.

$$MR = MC$$

SHADOW PRICE = 0 : NO re-allocation of resources.