OPERATIONAL RESEARCH

Section3

Modeling

2.6.6. "Product Mix Problem"

	Operation I	Operation II	Profit
X	3 hrs	4 hrs	Rs 10/unit
Y	4 hrs	5 hrs	Rs 20/unit
	20 hrs	26 hrs	

- Production of each unit Y → 2 units of a by-Prod. Z at no extra Cost.
- If Z is Sold → Rs. 6/unit
  else → Rs. 4/unit for destruction
- No more than 5 units of Z can be Sold.

Determine quantities of X and Y to be Produced Keeping Z in mind to maximize Profit

X_1 → # of units Produced from X
X_2 → # of units produced from Y
X_3 → # of units produced from Z

$Z = X_3 + X_4$
Sold ↙ ↘ Destroyed

Maximize $Z = 10X_1 + 20X_2 + 6X_3 - 4X_4$

Sub. to: $3X_1 + 4X_2 \leq 20$
$4X_1 + 5X_2 \leq 26$

$x_3 = 5$

$2x_2 = x_3 + x_4$

2.6-10 : "Blending Problem"

* Company produces two grades of gasoline P, Q. Sells at Rs.30 and Rs.40 per liter

* The Company can buy 4 different crude oil.

Crude oil	A	B	C	Price/Liter (Rs)
1	0.75	0.15	0.1	20
2	0.2	0.3	0.5	22.5
3	0.7	0.1	0.2	25
4	0.4	0.1	0.5	27.5

* Gasoline P → Must have at least 55% of A
And Not more than 40% of C

* Gasoline Q → Must not have more than 25% of C

Determine how the Crudes should be used to max. the profit?

X_{ij} → # of liters
i = Crude oil ($i = 1, 2, 3, 4$)
j = Gasoline ($j = P, Q$)

Maximize Z: $30[X_{1P} + X_{2P} + X_{3P} + X_{4P}]$
$+40[X_{1Q} + X_{2Q} + X_{3Q} + X_{4Q}]$
$-20[X_{1P} + X_{1Q}]$
$-22.5[X_{2P} + X_{2Q}]$
$-25[X_{3P} + X_{3Q}]$
$-27.5[X_{4P} + X_{4Q}]$

Sub.to:

$*0.75X_{1P} + 0.2X_{2P} + 0.7X_{3P} + 0.4X_{4P} \geq 0.55[X_{1P} + X_{2P} + X_{3P} + X_{4P}]$

$*0.1X_{1P} + 0.5X_{2P} + 0.2X_{3P} + 0.5X_{4P} \leq 0.4[X_{1P} + X_{2P} + X_{3P} + X_{4P}]$

$*0.1X_{1Q} + 0.5X_{2Q} + 0.2X_{3Q} + 0.5X_{4Q} \leq 0.25[X_{1Q} + X_{2Q} + X_{3Q} + X_{4Q}]$

2.6.11:

- Air Coolers Produced by a Company.
- Firm orders for next 6 months either regular or overtime

Month	1	2	3	4	5	6
Order	640	660	700	750	550	650
Cost (Reg)	40	42	41	45	39	40
Cost (Over)	52	50	53	50	45	43

- 100 Coolers in stock at present.
- 150 Coolers at least in stock at the end of 6 months
- Production in each month is not exceed 600 units in regular basis and 400 units in overtime.
- The inventory carrying cost for air coolers is 12 Rs. per unit per month.

Minimize Cost

X_{ij} → # units produced in month ($j=1 \to 6$) on regular or overtime basis ($i=1,2$)

Y_i → # units of ending inventory in month j ($j=1 \to 6$)

Minimize Cost $Z = (40x_{11} + 42x_{12} + 41x_{13} + 45x_{14} + 39x_{15} + 40x_{16})$
$+ (52x_{21} + 50x_{22} + 53x_{23} + 50x_{24} + 45x_{25} + 43x_{26})$
$+ 12(y_1 + y_2 + y_3 + y_4 + y_5 + y_6)$

Month 1: $100 + x_{11} + x_{21} - 640 = y_1$
Month 2: $y_1 + x_{12} + x_{22} - 660 = y_2$
Month 3: $y_2 + x_{13} + x_{23} - 700 = y_3$
Month 4: $y_3 + x_{14} + x_{24} - 750 = y_4$
Month 5: $y_4 + x_{15} + x_{25} - 550 = y_5$
Month 6: $y_5 + x_{16} + x_{26} - 650 = y_6$

$y_6 \geq 150$

* $x_{11}, x_{12}, x_{13}, x_{14}, x_{15}, x_{16} \leq 600$
$x_{21}, x_{22}, x_{23}, x_{24}, x_{25}, x_{26} \leq 400$