

* Data:

$$\text{Space per unit: 'S'} = \frac{1}{1000} \begin{bmatrix} 40 \\ 45 \\ 210 \end{bmatrix}$$

$$\text{profit per unit: 'p'} = \begin{bmatrix} 4 \\ 6 \\ 10 \end{bmatrix}$$

$$\text{'n-max': Demand} = \begin{bmatrix} 10,000 \\ 15,000 \\ 18,000 \end{bmatrix}$$

per product
per week

$$\text{'n-min': Min Supply} = \begin{bmatrix} 5000 \\ 0 \\ 4000 \end{bmatrix}$$

n: Units per week

$$\text{time per unit (u):} \begin{bmatrix} 6000 \\ 5000 \\ 3000 \end{bmatrix}$$
$$u = u - t =$$

Formulation

a) variable : $x \rightarrow$ proportion of time
per product
per day

obj $\eta = 5 \cdot (x \times \text{u.t})$ \hookrightarrow No. of units
per week

obj = max (total profit)

$$\rightarrow \max (p^T \eta)$$

Constraints

space : $s^T \eta \leq 6000$

Demand / Supply : $\eta_{\min} \leq \eta \leq \eta_{\max}$

$$x_1 + x_2 + x_3 = 1$$

b) Variable: y % No. of units per week

Here $y = n$

obj: $\max(p^T n)$

Constraint: $s^T n < 6000$

Demand/supply: $n_{\min} \leq n \leq n_{\max}$

Converting y to x :

$$x_1 = y_1 / 5u_1$$

$$x_2 = y_2 / 5u_2$$

$$x_3 = y_3 / 5u_3$$

$$\Rightarrow x_1 + x_2 + x_3 = 1$$

(c) Variable (x)

x_1 : No. of hours for iPod

x_2 : no. of hour for iPhone

x_3 : Total no. of hours

let hrs-per-product = $\begin{bmatrix} h_1 \\ h_2 \\ h_3 \end{bmatrix}$ = h
per week

$$n = \frac{5}{40} (h \cdot u \cdot t)$$

* obj: $\max(p^T n)$

* $x = h/40$

* Constraint:

$$s^T n \leq 6000$$

$$n_{\min} \leq n \leq n_{\max}$$

$$x_1 + x_2 + x_3 = 1$$

(d) Relation b/w x & z :

$$z_1 = 40x_1$$

$$z_2 = 40x_2$$

$$z_3 = 40(x_1 + x_2 + x_3)$$

* Relation b/w x & y

$$x_1 = y_1 / 5u_1$$

$$x_2 = y_2 / 5u_2$$

$$x_3 = y_3 / 5u_3$$

* Relation b/w y & z :

$$z_1 = \frac{8y_1}{u_1}$$

$$z_2 = \frac{8y_2}{u_2}$$

$$z_3 = 8 \left(\frac{y_1}{u_1} + \frac{y_2}{u_2} + \frac{y_3}{u_3} \right)$$