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15/ENG02/016
COMPUTER ENGINEERING
COE 512

QUESTION 2

Keyboard $\xrightarrow{\text{Produced}}$ Kansas & Mexico $\xrightarrow{\text{consumed}}$ New york & California

Kansas → 15 cartons of keyboards
Mexico → 8 cartons
} production

New york → 10
California → 13
} assumption

$4 cost Mexico - Newyork $- x_1$
$1 " Mexico - California $- x_2$
$2 " Kansas - New york $- x_3$
$3 " Kansas - California $- x_4$

Minimize the overall transportation cost

$$W = 4x_1 + x_2 + 2x_3 + 3x_4$$

Subject to

$$x_1 + x_3 \leq 10$$
$$x_2 + x_4 \leq 13$$
$$x_1 + x_2 \leq 8$$
$$x_3 + x_4 \leq 15$$

} constraints.

where x_1, x_2, x_3, x_4

$$\left[\begin{array}{cccc|c} 1 & 0 & 1 & 0 & 10 \\ 0 & 1 & 0 & 1 & 13 \\ 1 & 1 & 0 & 0 & 8 \\ 0 & 0 & 1 & 1 & 15 \\ \hline 4 & 1 & 2 & 3 & 0 \end{array}\right]$$

Transposing

$$\left[\begin{array}{cccc:c} 1 & 0 & 1 & 0 & 4 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 2 \\ 0 & 1 & 0 & 1 & 3 \\ \hdashline 10 & 13 & 8 & 15 & 0 \end{array}\right]$$

finding max value of $w = 10y_1 + 13y_2 + 8y_3 + 15y_4$

subject to constraints

four slack variables S_1, S_2, S_3, S_4

$$\begin{aligned} y_1 + y_3 &\le 4 \\ y_2 + y_3 &\le 1 \\ y_1 + y_4 &\le 2 \\ y_2 + y_4 &\le 3 \end{aligned}$$

where $0 = -10y_1 + 13y_2 - 8y_3 - 15y_4$

$$\left[\begin{array}{cccccccc:c} y_1 & y_2 & y_3 & y_4 & S_1 & S_2 & S_3 & S_4 & \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 4 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 2 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 3 \\ \hdashline -10 & -13 & -8 & -15 & 0 & 0 & 0 & 0 & 0 \end{array}\right] \quad \begin{array}{l} 4 \div 0 \to 0 \\ 1 \div 0 \to 0 \\ 2 \div 1 \to 2 \\ 3 \div 1 \to 3 \end{array}$$

↑

To get new row 4

→ $-1R_3 + R_4 \rightarrow R_4$

$$\left[\begin{array}{cccccccc|c} 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 4 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 2 \\ -1 & 1 & 1 & 0 & 0 & 0 & -1 & 1 & 1 \\ -10 & -13 & -4 & -15 & 0 & 0 & 0 & 0 & 0 \end{array}\right]$$

To get new row 5 $+15R_3 + R_5 \rightarrow R_5$

$$\left[\begin{array}{cccccccc|c} 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 4 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 2 \\ -1 & 1 & 1 & 0 & 0 & 0 & -1 & 1 & 1 \\ \hline 5 & -13 & -8 & 0 & 0 & 0 & 15 & 0 & 30 \end{array}\right]$$

$4 \div 0 = \times$

$1 \div 1 = 1$

$2 \div 0 = \times$

$1 \div 1 = 1$

↑ To get new row 4

$-1R_2 + R_4$

To get new row 5

$+13R_2 + R_5 \rightarrow R_5$

y_1	y_2	y_3	y_4	s_1	s_2	s_3	s_4	
1	0	1	0	1	0	0	0	4
0	1	1	0	0	1	0	0	1
1	0	0	1	0	0	1	0	2
-1	0	0	0	0	-1	-1	0	0
5	0	5	0	0	13	15	0	43

$y_2 = 1$

$y_4 = 2$

$s_1 = 4$ //

from the simplex table, maximum value of

$w = 43$

orginal problem (minimization)

$w = 43$

when $s_1 = 0$, $s_2 = 13$, $s_3 = 15$, $s_4 = 0$

QUESTION 1

First step: Definition of variables

w_i = number of workers during ith month

$w_0 = 30$

x_i = carpets made per month → ₦2000 salary

y_i = number of carpets made in the ith month

a_i, b_i = number of workers hired / fired respectively

s_i = no carpets stored ; $s_0 = 0$ (no initial surplus for storage)

Constraints

$w_0, w_i, x_i, y_i, a_i, b_i, s_i, s_0 \geq 0, \quad (i = 1 \ldots 12)$

Total number of carpets

$$y_i = 20w_i + x_i$$

no workers at the start of the month

$$w_i = w_i - 1 + (a_i - b_i)$$

Stored carpet

$$s_i = s_i - 1 + y_i - d$$

where $d \rightarrow$ carpet demand per month

Hiring costs ₦320, firing cost ₦400 per worker

minimization of cost

$$= 2000\sum w_i + 320\sum a_i + 400\sum b_i + 8\sum s_i + \sum y_i + 180\sum x_i$$