IS/ENG/02/028
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Number 1

Objective function:

Min $2000\sum_i z_i + 320\sum_i h_i + 400\sum_i f_i + 3\sum_i s_i$
$+ 180\sum_i y_i$

Subject to:

$x_i = 20z_i + y_i$; total no of carpets made per month.

$z_i = z_{i-1} + h_i - f_i$; no of workers at the beginning of each month

$s_i = s_{i-1} + x_i - d_i$; no of carpets stored

$y_i \le 6z_i$; overtime limit

$z_i, y_i, x_i, h_i, f_i, s_i, s_0 \ge 0$

when $i = 1, 2, 3, 4, \ldots, 12$ and $z_0 = 30$

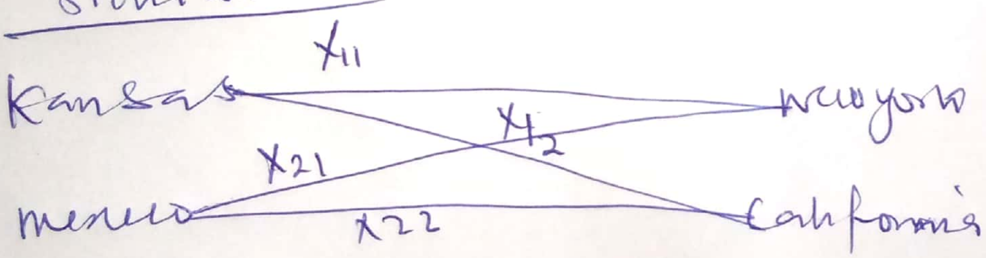
Number 2: Resolving the data into the tables below;

City	Cartons
Kansas	15
Mexico	8

City	Bags
Newyork	10
California	13

City	Cost to Shipping	
	Newyork	California
Kansas	2	3
Mexico	4	1

Solution:



Objective function:

$$\min Z = 2x_{11} + 3x_{12} + 4x_{21} + x_{22}$$

Subject to;

$$\left.\begin{aligned} x_{11} + x_{12} &\le 15 \\ x_{21} + x_{22} &\le 8 \end{aligned}\right\} \text{production Constraint}$$

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$$\left.\begin{array}{l} x_{11} + x_{21} \le 10 \\ x_{12} + x_{22} \le 13 \end{array}\right\}$$ Con sumption Constraint

$$x_{11}\ x_{12}\ x_{21}\ x_{22} \ge 0$$

The augmented matrix corresponding to this minimization problem is

$$\begin{array}{ccccc} x_{11} & x_{12} & x_{21} & x_{22} & \\ 1 & 1 & 0 & 0 & 15 \\ 0 & 0 & 1 & 1 & 8 \\ 1 & 0 & 1 & 0 & 10 \\ 0 & 1 & 0 & 1 & 13 \\ \hline 2 & 3 & 4 & 1 & 0 \end{array}$$

Taking the transpose of the matrix above

$$\begin{array}{ccccc} y_{11} & y_{12} & y_{21} & y_{22} & \\ 1 & 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 1 & 3 \\ 0 & 1 & 1 & 0 & 4 \\ 0 & 1 & 0 & 1 & 1 \\ \hline 15 & 8 & 10 & 13 & 0 \end{array}$$

thus the dual maximisation problem is

$$Z = 15y_{11} + 8y_{12} + 10y_{21} + 13y_{22}$$

subject to:

$$y_{11} + y_{21} \leq 2$$
$$y_{11} + y_{22} \leq 3$$
$$y_{12} + y_{21} \leq 4$$
$$y_{12} + y_{22} \leq 1$$

Adding the slack variables to the constants

$y_{11} + y_{21} + s_1 \leq 2$

$y_{11} + y_{22} + s_2 \leq 3$

$y_{12} + y_{21} + s_3 \leq 4$

$y_{12} + y_{22} + s_4 \leq 1$

	y_{11}	y_{12}	y_{21}	y_{22}	s_1	s_2	s_3	s_4		Constant
R_1	1	0	1	0	1	0	0	0		2
R_2	1	0	0	1	0	1	0	0		3
R_3	0	1	1	0	0	0	1	0		4
R_4	0	1	0	1	0	0	0	1		1
R_5	-15	-8	-10	-13	0	0	0	0	1	0

↑
most negative

$2/1 = 2$ $\quad 1/0 = 0$

$3/1 = 3$

$4/0 = 0$

$R_2 \to R_2 - R_1$
$R_5 \to R_5 + 15R_1$
$R_3 \to R_3$
$R_4 \to R_4$

Applying this to the rows we have

	y_{11}	y_{12}	y_{21}	y_{22}	S_1	S_2	S_3	S_4	Z
R_1	1	0	1	0	1	0	0	0	2
R_2	0	0	-1	1	-1	1	0	0	1
R_3	0	1	1	0	0	0	1	0	4
R_4	0	1	0	1	0	0	0	1	1
R_5	0	-8	5	-13	+15	0	0	0	+30

↑ most negative

$2/0$ = undefined

$1/1 = 1$

$4/0$ = undefined

$1/1 = 1$

$R_4 \Rightarrow R_4 - R_2$

$R_5 \rightarrow R_5 + 13R_2$

$R_1 \rightarrow R_1$ $\quad R_3 \rightarrow R_3$

$R_2 \rightarrow R_2$

	y_{11}	y_{12}	y_{21}	y_{22}	S_1	S_2	S_3	S_4	Z
R_1	1	0	1	0	1	0	0	0	2
R_2	0	0	-1	1	-1	1	0	0	1
R_3	0	1	1	0	0	0	1	0	4
R_4	0	1	1	0	1	-1	0	1	0
R_5	0	-8	-8	0	2	13	0	0	43

↑

$2/0 =$ undefined

$1/0 =$ undefined

$4/1 = 4$

$0/1 = 0$

$R_4 \rightarrow R_4 - R_3$

$R_5 \rightarrow R_5 + 8R_3$

$R_1 \rightarrow R_1$

$R_2 \rightarrow R_2$

$R_3 \rightarrow R_3$

	Y_{11}	Y_{12}	Y_{21}	Y_{22}	S_1	S_2	S_3	S_4	
R_1	1	0	1	0	1	0	0	0	2
R_2	0	0	-1	1	-1	1	0	0	1
R_3	0	1	1	0	0	0	1	0	4
R_4	0	0	0	0	1	-1	-1	1	-4
R_5	0	0	0	0	2	13	8	0	75
					x_{11}	x_{12}	x_{21}	x_{22}	

therefore :

$x_{11} = 2$ //

$x_{12} = 13$ //

$x_{21} = 8$ //

$x_{22} = 0$ //

and lastly $\min Z = 75$ //