Samuel Ubitogbe
15/Eng02/029
Computer Engineering
Reliability and Maintainability Cpe 212

1. Solution

w_i = number of workers during ith month
D_i - demand for ith month
O_i = number made by over-time ith month
$h_i f_i$ = number of workers hired and fired respectively at the beginning of month i
x_i = number of carpets made during ith month
S_i - number of stored carpet at the end of ith month
All variable must be non negative
$w_i\ x_i\ o_i\ h_i\ f_i\ s_i \geq 0,\ i = 1 \ldots 12$

Total carpets made per month
$x_i = 20w_i + o_i$

potential total number of workers at the start of each month $w_i = w_{i-1} + h_i - f_i$

number of carpets stored
$s_i = s_{i-1} + x_i - d_i$

Limits of overtime
$o_i \leq 6w_i$

To minimize the total cost ~~which is the objective~~?

Linear program

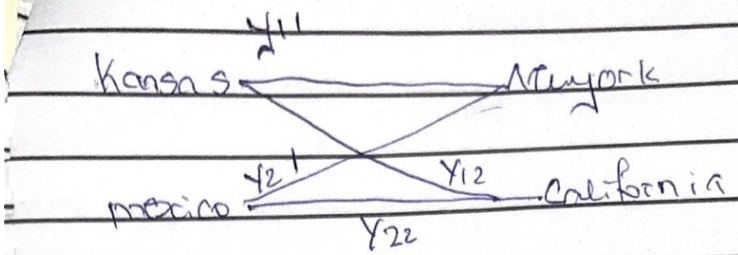
$$\min\ 2000\sum_{i=1} w_i + 320\sum_{i} h_i + 400\sum_{i} f_i + 8\sum_{i} s_i + 180\sum_{i} o_i$$

places	Cartoon
Kansas	15
Mexico	8

places	beans
Newyork	10
California	13

places	cost of shipping to Newyork
kansas	2
Mexico	4

places	cost of shipping to California
Kansas	3
Mexico	1



Production Constraints

$Y_{11} + Y_{12} \leq 15$

$Y_{21} + Y_{22} \leq 8$

Consumers Constraints

$Y_{11} + Y_{21} \leq 10$

$Y_{12} + Y_{22} \leq 13$

Objective function

$\text{Min } Z = a_{11} Y_{11} + a_{12} Y_{12} + + a_{21} Y_{21} + a_{22} Y_{22}$

$2Y_{11} + 3Y_{12} + 4Y_{21} + Y_{22}$

A

Add slacks

Let $x_{11} = x_1$

$x_{12} = x_2$

$x_{21} = x_3$

$x_{22} = x_4$

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

$x_1 + x_2 + s_1 = 15$

$x_3 + x_4 + s_2 = 8$

$x_1 + x_3 + s_3 = 10$

$x_2 + x_4 + s_4 = 13$

$Z - 2x_1 - 3x_2 - 4x_3 - x_4 = 0$

Iter	Basis	x_1	x_2	x_3	x_4	s_1	s_2	s_3	s_4	RHS	Ratio
0	Z	-2	-3	-4	-1	0	0	0	0	0	Ratio
	s_1	1	1	0	0	1	0	0	0	15	$15/0 = 0$
	s_2	0	0	1	1	0	1	0	0	8	$8/1 = 8$
	s_3	1	0	1	0	0	0	1	0	10	$10/1 = 10$
	s_4	0	1	0	1	0	0	0	1	13	$13/0 = 0$

Most negative value from Z row is -4 hence we make x_3 key column. Therefore s_2 is the key row

Iter		x_1	x_2	x_3	x_4	s_1	s_2	s_3	s_4	RHS	Ratio
[4+4x]	Z	-2	-3	0	3	0	4	0	0	32	
	s_1	1	1	0	0	1	0	0	0	15	$15/1 = 15$
	s_2	0	0	1	1	0	1	0	0	8	$8/0 = 0$
$-s_3 - x_1$	s_3	1	0	0	-1	0	-1	1	0	2	$2/0 = 0$
	s_4	0	1	0	1	0	0	0	1	13	$13/1 = 0$

lowest Z value is -3

Itr	Basic Vars	x_1	x_2	x_3	x_4	s_1	s_2	s_3	s_4	RHS	Ratio
x_2+x_4	Z	-2	0	0	6	0	4	6	3	71	
	s_1	1	0	0	-1	1	0	0	-1	2	2/1 = 2
	x_3	0	0	1	1	0	1	0	0	8	8/0 = ∞
	s_2	1	0	0	-1	0	-1	1	0	2	2/1 = 2
	x_2	0	1	0	1	0	0	0	1	13	13/0 = ∞

Since -2 is the least value

we pick x_1 key colum

s_1 as key row

Itr	Basic Vars	x_1	x_2	x_3	x_4	s_1	s_2	s_3	s_4	RHS	Ratio
$3c_2+z=0$	Z	0	0	0	4	2	4	0	1	15	
	x_1	1	0	0	-1	1	0	0	-1	2	
	x_3	0	0	1	1	0	1	0	0	8	
$c_3 - x_1$	s_3	0	0	0	0	-1	-1	1	1	0	
	x_2	0	1	0	1	0	0	0	1	13	

Therefore: $x_1 = 2$

$x_2 = 13$

$x_3 = 8$

$x_4 = 0$

Hence Z_{min} (minimum cost) = 75