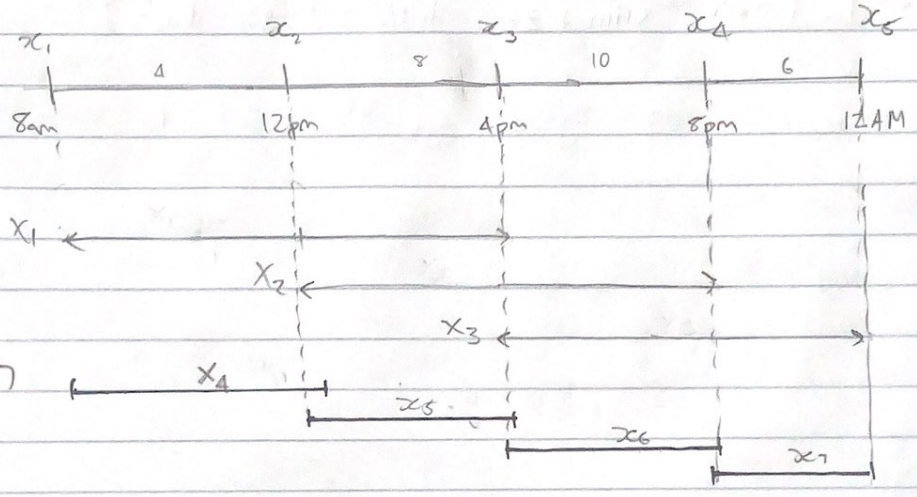
QMIM Assignment 2.

1)

Fulltime = x_j where j (shift) = 1, 2, 3...



Fulltime — x_i

Part-Time — x_j

where $i = 1, 2, 3$

$j = 4, 5, 6, 7$

Min Cost Staffing Plan: Min # of consultants 28 per day.

Minimize $Z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7$

ST:

Constraints: $x_1 + x_4 \geq 4$

$x_1 + x_2 + x_5 \geq 8$

$x_2 + x_3 + x_6 \geq 10$

$x_3 + x_7 \geq 6$

fulltime $\geq$ Part time

$\therefore x_i \geq x_j$

$x_i \geq 0$

$x_j \geq 0$

So Total # of full time = $\frac{28}{4} = 7$ employees

$\therefore$ # of Part time = 14 employees

Min cost daily staffing Plan: 8 hour shift @ 14/hr = \$112

So for full time = $7 \cdot 112 = \$784$ cost

for Part time = $14 \cdot 48 = \$672$ cost

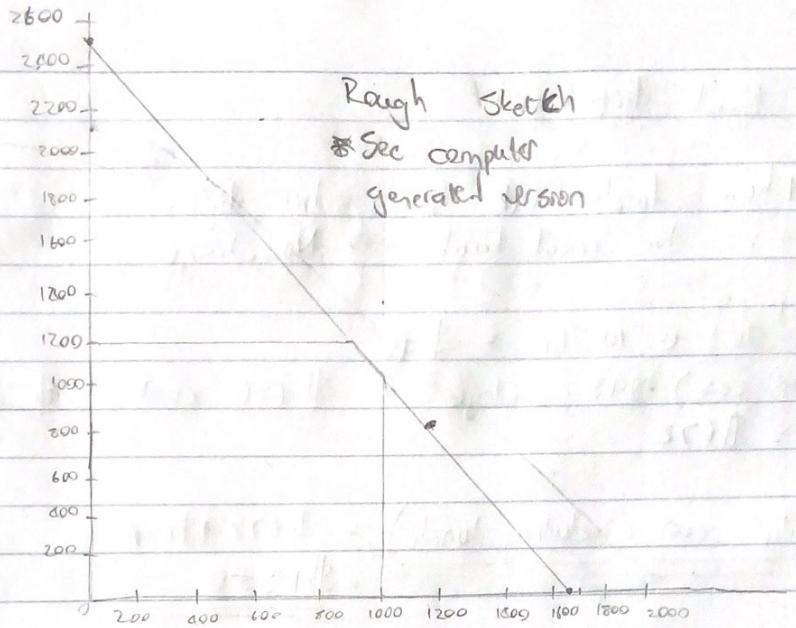
$\therefore$ Min daily staffing Cost = $\$784 + \$672 = \underline{\$1456}$

16) Recognizing Meal Breaks.

Full time = 1 hour lunch break per 8 hr shift.
Part time : No meal break. → No change

Full time: 7hr shift @ 14/hr = $98
(7 employees) · $98/employee = $686 cost with lunch brea
Part time = $672

∴ Min daily cost (including lunch) = $672 + $686
= $1358



Rough Sketch
* See computer generated version

$Y = mx + c$

$Z = 32X_1 + 24X_2$ gradient form: $X_2 = \frac{32}{-24}X_1 + \frac{Z}{24}$

Intersection of lines ii & iv → (800; 1200)
Intersection of lines ii & iii → (1000; 974.51)
Intersection of lines i & iv → (866.67; 1200)
Intersection of lines i & iii → (1000; 1000)
Intersection of i & ii → (1067.86; 898.20359)

@ Point (800, 1200): $Z = 32(800) + 24(1200) = \$54\,400$

Max $Z = 32(1000) + 24(974.51) = \boxed{\$55\,388,24}$

$Z = 32X_1 + 24X_2$

ST constraints: i) $3X_1 + 2X_2 \leq 5000$
ii) $0.75X_1 + 0.667X_2 \leq 1400$
iii) $X_1 \leq 1000$ ✓
iv) $X_2 \leq 1200$ ✓

Intersection: $X_1 = 1067.86$, $X_2 = 898.20359$

$X_1 \geq 0$
$X_2 \geq 0$

line Points i) $3(x_1) + 2(x_2) \leq 5000$
(0 ; 2500)
(1666.667 ; 0)

ii) $0.75(x_1) + 0.667(x_2) \leq 1400$
(0 ; 2098.95)
(1866.667 ; 0)

3)

Plant 1 Plant 2 Plant 3

Max Profit $Z = 420X_{ij} + 360X_{2j} + 300X_{3j}$

	$X_j = 1$ Large	$X_{i=2}$ Medium	$X_{i=3}$ Small	Production Limits (units)	Storage Space	ft^2
$X_j=1$ Plant 1	X_{11} =	X_{21} =	X_{31} =	750	13 000	
$X_j=2$ Plant 2	X_{12} =	X_{22} =	X_{32} =	900	12 000	
$X_j=3$ Plant 3	X_{13} =	X_{23} =	X_{33} =	450	5000	
Profit/unit	$ 420	$ 360	$ 300			

Units Sold per day 900 1200 750

Plant 1 Plant 2

$Z = (420X_{11} + 360X_{21} + 300X_{31}) + (420X_{12} + 360X_{22} + 300X_{32}) +$
$(420X_{13} + 360X_{23} + 300X_{33})$

Plant 3

ST :

$$\left.\begin{aligned} X_{11} + X_{21} + X_{31} &\leq 750 \\ X_{12} + X_{22} + X_{32} &\leq 900 \\ X_{13} + X_{23} + X_{33} &\leq 450 \end{aligned}\right\} \text{ Supply}$$

$$\left.\begin{aligned} 20X_{11} + 15X_{21} + 12X_{31} &\leq 13\,000 \\ 20X_{12} + 15X_{22} + 12X_{32} &\leq 12\,000 \\ 20X_{13} + 15X_{23} + 12X_{33} &\leq 5000 \end{aligned}\right\} \text{ Storage}$$

$$\left.\begin{aligned} X_{11} + X_{12} + X_{13} &\leq 900 \\ X_{21} + X_{22} + X_{23} &\leq 1200 \\ X_{31} + X_{32} + X_{33} &\leq 750 \end{aligned}\right\} \text{ Sold per day Demand}$$

$X_{ij} \geq 0$ for all

According to lp model

$$Z = 420(350) + 360(400) + 300(0) + 420(0) + 360(400) + 300(500) + 420(0) + 360(133.3333) + 300(250)$$

$$Z = \$707,999.99$$