

Assignment2-MIS-64018-Mukhtar

Solutions 1, 2, and 3

Other relevant pdf files are attached to my GitHub account. The link is submitted to Canvas, Prof.

soln 1 Computer Staffing

P_a = Part time
 F_a = Full time

part a let's assume that:-
 F_a = # of full-time staff for shift a
 P_a = # of part-time staff for shift a

$F_a = 1, 2, 3 \times (8 \text{ to } 12, 12 \text{ to } 4, 4 \text{ to } 12)$
 $P_a = 1, 2, 3, 4 \times (8 \text{ to } 12, 12 \text{ to } 4, 4 \text{ to } 8, 8 \text{ to } 12)$

Min $Z = 112F_1 + 112F_2 + 112F_3 + 48P_1 + 48P_2 + 48P_3 + 48P_4$
s.t.

$$\begin{aligned} F_1 + P_1 &\geq 4 \\ F_1 + F_2 + P_2 &\geq 8 \\ F_2 + F_3 + P_3 &\geq 10 \\ F_3 + P_4 &\geq 6 \\ F_1 &\geq P_1 \\ F_1 + F_2 &\geq P_2 \\ F_2 + F_3 &\geq P_3 \\ F_3 &\geq P_4 \end{aligned}$$

part b $\therefore F_1, F_2, F_3, P_1, P_2, P_3, P_4 \geq 0$

let's assume: Staff that take lunch from shift a in the 4th hour = F_{a4}
Staff that take lunch from shift a in the 5th hour = F_{a5}

we now Min 2: $112F_1 + 112F_2 + 112F_3 + 48P_1 + 48P_2 + 48P_3 + 48P_4$
again

s.t.

$$\begin{aligned} F_1 &= F_{14} + F_{15} \\ F_2 &= F_{24} + F_{25} \\ F_3 &= F_{34} + F_{35} \end{aligned}$$

$$\begin{aligned} F_1 &= F_{14} + F_{15} \\ F_2 &= F_{24} + F_{25} \\ F_3 &= F_{34} + F_{35} \end{aligned}$$

$F_1 + P_1$	≥ 4	(8 & 9)
$F_1 + P_1$	≥ 4	(9 & 10)
$F_1 + P_1$	≥ 4	(10 & 11)
$F_1 + P_1$	≥ 4	(11 & 12)
$F_1 + F_2 + P_2$	≥ 8	(12 & 1)
$F_1 + F_2 + P_2$	≥ 8	(1 & 2)
$F_1 + F_2 + P_2$	≥ 8	(2 & 3)
$F_1 + F_2 + P_2$	≥ 8	(3 & 4)
$F_2 + F_3 + P_3$	≥ 10	(4 & 5)
$F_2 + F_3 + P_3$	≥ 10	(5 & 6)
$F_2 + F_3 + P_3$	≥ 10	(6 & 7)
$F_2 + F_3 + P_3$	≥ 10	(7 & 8)
$F_3 + P_4$	≥ 6	(8 & 9)
$F_3 + P_4$	≥ 6	(9 & 10)
$F_3 + P_4$	≥ 6	(10 & 11)
$F_3 + P_4$	≥ 6	(11 & 12)

F_1	$\geq P_1$	(8 & 9)
F_1	$\geq P_1$	(9 & 10)
F_1	$\geq P_1$	(10 & 11)
F_1	$\geq P_1$	(11 & 12)
$F_1 + F_2$	$\geq P_2$	(12 & 1)
$F_1 + F_2$	$\geq P_2$	(1 & 2)
$F_1 + F_2$	$\geq P_2$	(2 & 3)
$F_1 + F_2$	$\geq P_2$	(3 & 4)
$F_2 + F_3$	$\geq P_3$	(4 & 5)
$F_2 + F_3$	$\geq P_3$	(5 & 6)
$F_2 + F_3$	$\geq P_3$	(6 & 7)
$F_2 + F_3$	$\geq P_3$	(7 & 8)
$F_3 + P_4$	$\geq P_4$	(8 & 9)
$F_3 + P_4$	$\geq P_4$	(9 & 10)
$F_3 + P_4$	$\geq P_4$	(10 & 11)
$F_3 + P_4$	$\geq P_4$	(11 & 12)

F_1, F_2, F_3, F_4, F_5
 F_2, F_3, F_4, F_5
 P_1, P_2, P_3, P_4
 ≥ 0

② The Mathematical formula - Bayes Saver

- ✓ Weekly demand of backpack = 5,000 square foot
- ✓ Collegiate = X_1
- Mini = X_2
- $X_1 \geq 1,000$
- $X_2 \geq 1,200$
- ✓ To maximize Profit: $= 32X_1 + 24X_2$
- ✓ We know that 3 and 2 required sq. feet of each has a demand of 5000
- ✓ 1 week = 24 hrs \times 7 days \times 60 minutes = 10,080 minutes
- 1 Collegiate requires \rightarrow 45 min
- 1 Mini \rightarrow 40 min, so $35 \times 40 \times 60 = 84,000$ Minutes
- ✓ we now have:

$$\begin{aligned} 32X_1 + 24X_2 &\leq 5000 \\ 45X_1 + 40X_2 &\leq 84,000 \\ X_1, X_2 &\geq 0 \end{aligned}$$

③ Soln:

we need to define the following:

L = Large units

M = Medium units

S = Small units

P = Plants

we now define:

# large units Produced/day at P ₁	=	L ₁
# Medium \checkmark	P ₁	= M ₁
# Small units \checkmark	@ P ₁	= S ₁
# large units \checkmark	@ P ₂	= L ₂
# Medium units \checkmark	@ P ₂	= M ₂
# Small units \checkmark	@ P ₂	= S ₂
# large units \checkmark	@ P ₃	= L ₃
# Medium units \checkmark	@ P ₃	= M ₃
# Small units \checkmark	@ P ₃	= S ₃

The Objective function:

$$\text{Max: } Z \quad 420L_1 + 360M_1 + 300S_1 + 420L_2 + 360M_2 + 300S_2 + 420L_3 + 360M_3 + 300S_3$$

S.T

$$\begin{aligned} L_1 + M_1 + S_1 &\leq 750 \\ L_2 + M_2 + S_2 &\leq 360 \\ L_3 + M_3 + S_3 &\leq 450 \end{aligned}$$

Required SGR for:

$$20L_1 + 15M_1 + 12S_1 \leq 13,000$$

$$20L_2 + 15M_2 + 12S_2 \leq 12,000$$

$$20L_3 + 15M_3 + 12S_3 \leq 5,000$$

Sales forecast

$$L_1 + L_2 + L_3 \leq 900$$

$$M_1 + M_2 + M_3 \leq 1,200$$

$$S_1 + S_2 + S_3 \leq 750$$

Management decided that Plants should use some % of their excess capacity to produce new product; therefore

$$\frac{1}{750}(L_1 + M_1 + S_1) - \frac{1}{450}(L_3 + M_3 + S_3) = 0$$

$$\frac{1}{750}(L_1 + M_1 + S_1) - \frac{1}{900}(L_2 + M_2 + S_2) = 0$$

$$\frac{1}{900}(L_2 + M_2 + S_2) - \frac{1}{750}(L_1 + M_1 + S_1) = 0$$

NNh: $L_1 \geq 0, M_1 \geq 0, S_1 \geq 0$

$$L_2 \geq 0, M_2 \geq 0, S_2 \geq 0$$

$$L_3 \geq 0, M_3 \geq 0, S_3 \geq 0$$

Solve this graphically using / solve or any other equivalent library in R.