Assignment-2

Question 1:

Part A:

Finding decision variables:

The full-time consultants can work for eight consecutive hours in any of the following shifts in a day, and Full-time consultants are paid $14 per hour.

Morning (8 am – 4 pm) : **F1**
Afternoon (12pm – 8 pm) : **F2**
Evening (4 pm – 12am) : **F3**

Part-time consultants can work any of the four shifts listed below, and Part-time consultants are paid $12 per hour.

8am – 12pm : **P1**
12pm – 4pm : **P2**
4am – 8pm : **P3**
8 am – 12am : **P4**

From above definition, we can find there are 7 decision variables.

For 8hrs, full-time consultants get paid (8*14) = $112
For 4hrs, Part-time consultants get paid (4*12) = $48

Objective Function:

Minimize Z = 112(F1+F2+F3) + 48(P1+P2+P3+P4)

Constraints:

$P_i, F_j \geq 0$, part time shifts, i = 1,2,3,4
Full time shifts, j= 1,2,3

$F1 + P1 \geq 4$	$F1 \geq P1$
$F1 + P2 + F2 \geq 8$	$F1 + F2 \geq P2$
$F2 + P3 + F3 \geq 10$	$F2 + F3 \geq P3$
$P4 + F3 \geq 6$	$F3 \geq P4$

Part B:

Full-time consultants are entitled to a one-hour lunch break during their eight-hour shift. So, reducing the cost of 1 hour, $112 - $14 = $98.

Cost Minimize, Z = 98(F1 + F2 + F3) + 48(P1 + P2 + P3 + P4)

Question 2:

Please find the below graphical solution from excel.

Assign_2.xlsx

Question 3:

Part A:

The decision variables are framed below:

P is the number of products produced per day
i =1,2,3. where i is the plant number
j = 1,2,3. Where j is the size of the products produced per day. 1: small, 2: Medium, 3: Large

Therefore, the decision variables are stated by

P_{1S} = Plant 1 - number of small products produced per day,
P_{1M} = Plant 1 - number of medium products produced per day,
P_{1L} = Plant 1 - number of large products produced per day,
P_{2S} = Plant 2 - number of small products produced per day,
P_{2M} = Plant 2 - number of medium products produced per day,
P_{2L} = Plant 2 - number of large products produced per day,
P_{3S} = Plant 3 - number of small products produced per day,
P_{3M} = Plant 3 - number of medium products produced per day,
P_{3L} = Plant 3 - number of large products produced per day,

Part B:

Objective Function:

Maximize Z = $300P_{1S}+360P_{1M}+420P_{1L}+ 300P_{2S}+360P_{2M}+420P_{2L+} 300P_{3S}+360P_{3M}+420P_{3L}$

Constraints:

Each Plant excess capacity to produce:

$P_{1S}+P_{1M}+P_{1L} \leq 750$
$P_{2S}+P_{2M}+P_{2L} \leq 900$
$P_{3S}+P_{3M}+P_{3L} \leq 450$

Storage space limitation for new product:

$20P_{1S}+15P_{1M}+12P_{1L} \leq 13000$
$20P_{2S}+15P_{2M}+12P_{2L} \leq 12000$
$20P_{3S}+15P_{3M}+12P_{3L} \leq 5000$

New products sales forecast per day:

$P_{1L}+P_{2L}+P_{3L} \leq 900$
$P_{1M}+P_{2M}+P_{3M} \leq 1200$

$P_{1S}+P_{2S}+P_{3S} \leq 750$

And $P_{ij} \geq 0$, where i,j= 1,2,3.

The below set of constraints are the layoffs of the plants

$$\frac{1}{750}(P_{1S} + P_{1M} + P_{1L}) - \frac{1}{900}(P_{2S} + P_{2M} + P_{2L}) = 0$$

$$\frac{1}{750}(P_{1S} + P_{1M} + P_{1L}) - \frac{1}{450}(P_{3S} + P_{3M} + P_{3L}) = 0$$

Part C:

Please find the below R Script.

Assign_2.R