(B) Soln 1a, 1b is solved in r and is in my Github account.
we need to define the following:

$$L = \text{Large units} \qquad\qquad P = \text{Plants}$$
$$M = \text{Medium units}$$
$$S = \text{Small Units}$$

we now define:

# large units Produced/day at P_1	$= L_1$
# Medium ✓	P_1	$= M_1$
# Small Units ✓ @ P_1	$= S_1$
# large units ✓ @ P_2	$= L_2$
# Medium Units ✓ @ P_2	$= M_2$
# Small Units ✓ @ P_2	$= S_2$
# large Units ✓ @ P_3	$= L_3$
# Medium Units ✓ @ P_3	$= M_3$
# Small Units ✓ @ 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

$$L_1 + M_1 + S_1 \leq 750$$
$$L_2 + M_2 + S_2 \leq 360 \;\; 900$$
$$L_3 + M_3 + S_3 \leq 450$$

Required sqr foot:

$$20 L_1 + 15 M_1 + 12 S_1 \leq 13{,}000$$
$$20 L_2 + 15 M_2 + 12 S_2 \leq 12{,}000$$
$$20 L_3 + 15 M_3 + 12 S_3 \leq 5{,}000$$

Sales forecast

$$L_1 + L_2 + L_3 \leq 900 \quad *$$
$$M_1 + M_2 + M_3 \leq 1{,}200 \quad *$$
$$S_1 + S_2 + S_3 \leq 750 \quad *$$

Management decided that Plants should use same % of their excess capacity to Produce new Product; therefore

$$\tfrac{1}{750}(L_1 + M_1 + S_1) - \tfrac{1}{450}(L_3 + M_3 + S_3) = 0$$
$$\tfrac{1}{750}(L_1 + M_1 + S_1) - \tfrac{1}{900}(L_2 + M_2 + S_2) = 0$$
$$\tfrac{1}{900}(L_2 + M_2 + S_2) - \tfrac{1}{750}(L_1 + M_1 + S_1) = 0$$

NNh:

$$L_1 \geq 0, \quad M_1 \geq 0, \quad S_1 \geq 0$$
$$L_2 \geq 0, \quad M_2 \geq 0, \quad S_2 \geq 0$$
$$L_3 \geq 0, \quad M_3 \geq 0, \quad S_3 \geq 0$$

Solve this analytically using lpsolve or any other equivalent library in R.

Same percentage capacity:

$$900 L_1 + 900 M_1 + 900 S_1 - 750 L_2 - 750 M_2 - 750 S_2 = 0$$
$$450 L_1 + 450 M_1 + 450 S_1 - 750 L_3 - 750 M_3 - 750 S_3 = 0$$

Soln.2

SHADOW PRICES

0.00   0.60 0.00 12.00 20.00 60.00 0.00 0.00 0.00 −0.08 0.56

DUAL SOLUTION

0.00 0.00 0.00 12.00 20.00 60.00 0.00 0.00 0.00 −0.08 0.56

REDUCED COST

0   0   −24   −40   0   0   −360   −120   0

Assgt 3

Soln
4.a.

Weight dual objective function:

Min: $750y_1 + 900y_2 + 450y_3 + 13,000y_4 + 12,000y_5 + 5,000y_6 + 900y_7 +$

$$1,200y_8 + 750y_9;$$

Constraints

$y_1 + 20y_4 + y_7 + 900y_{10} + 450y_{11} \geqslant 420$

$y_1 + 15y_4 + y_8 + 900y_{10} + 450y_{11} \geqslant 360$

$y_1 + 12y_4 + y_9 + 900y_{10} + 450y_{11} \geqslant 300$

$y_2 + 20y_5 + y_7 \pm 750y_{10} \geqslant 420$

$y_2 + 15y_5 + y_8 - 750y_{10} \geqslant 360$

$y_2 + 12y_5 + y_9 - 750y_{10} \geqslant 300$

$y_3 + 20y_6 + y_7 - 750y_{11} \geqslant 420$

$y_3 + 15y_6 + y_8 - 750y_{11} \geqslant 360$

$y_3 + 12y_6 + y_9 - 750y_{11} \geqslant 300$