

The LP Model Assignment

1. Back Savers

a) Decision variables are number backpacks to be produced per model per week

x_1 – number of collegiate backpacks to be produced per week

x_2 – number of mini backpacks to be produced per week

b) Objective function is to determine what quantities of collegiate and mini backpacks will generate the most profit. The company makes \$32 in profit per collegiate backpack and \$24 in profit per mini backpack.

$$\text{Max: } Z = 32x_1 + 24x_2$$

c) Constraints in this problem are:

1. The supplier can only supply 5,000 sq ft nylon per week that is to be used for both backpacks
2. Available labor per week is limited to 84,000 min (35 employees*40hours*60minutes)
3. The company can only sell maximum of 1,000 collegiate backpack per week
4. The company can only sell maximum of 1,200 mini backpack per week
5. All decision variables are non-negative

d)

$$\text{Max: } Z = 32x_1 + 24x_2$$

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$$3x_1 + 2x_2 \leq 5,000$$

$$45x_1 + 40x_2 \leq 84,000$$

$$x_1 \leq 1,000$$

$$x_2 \leq 1,200$$

$$x_1, x_2 \geq 0$$

2. The Weigelt Corp

a) Decision variables are the quantities of each size to be produced at each plant.

| Size | Plant | | |
|--------|-------|-------|-------|
| | 1 | 2 | 3 |
| Large | x_1 | x_2 | x_3 |
| Medium | x_4 | x_5 | x_6 |
| Small | x_7 | x_8 | x_9 |

b) The Weigelt Corporation

$$\text{Max: } Z = 420 (x_1 + x_2 + x_3) + 360 (x_4 + x_5 + x_6) + 300 (x_7 + x_8 + x_9)$$

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Daily sales limits:

$$x_1 + x_2 + x_3 \leq 900$$

$$x_4 + x_5 + x_6 \leq 1,200$$

$$x_7 + x_8 + x_9 \leq 750$$

Daily production limit:

$$x_1 + x_4 + x_7 \leq 750$$

$$x_2 + x_5 + x_8 \leq 900$$

$$x_3 + x_6 + x_9 \leq 450$$

Daily in-process storage space limit:

$$20x_1 + 15x_4 + 12x_7 \leq 13,000$$

$$20x_2 + 15x_5 + 12x_8 \leq 12,000$$

$$20x_3 + 15x_6 + 12x_9 \leq 5,000$$

The same percentage of excess capacity limit:

$$\frac{x_1 + x_4 + x_7}{750} = \frac{x_2 + x_5 + x_8}{900}$$

$$\frac{x_2 + x_5 + x_8}{900} = \frac{x_3 + x_6 + x_9}{450}$$

$$\frac{x_3 + x_6 + x_9}{450} = \frac{x_1 + x_4 + x_7}{750}$$

Converting above equations into a linear form as follows:

$$6(x_1 + x_4 + x_7) - 5(x_2 + x_5 + x_8) = 0$$

$$(x_2 + x_5 + x_8) - 2(x_3 + x_6 + x_9) = 0$$

$$5(x_3 + x_6 + x_9) - 3(x_1 + x_4 + x_7) = 0$$

Nonnegativity:

$$x_j \geq 0, \text{ for } j = 1, 2, \dots, 9$$