Module 2 - The LP Model

Problem 1: Back Savers Backpack Production

a) Decision Variables

Symbol	Definition
x1	**Collegiate backpacks produced per week**
x2	**Mini backpacks produced per week**

b) Objective Function

Maximize weekly profit:

$Z = 32x1 + 24x2$

c) Constraints

Type	Constraint per week
Material -> Nylon	**$3x1 + 2x2 \leq 5000$ sq ft**
Labor	**$45x1 + 40x2 \leq 84000$ minutes**
Sales limits	**$x1 \leq 1000$; $x2 \leq 1200$**
Non-negativity	**$x1, x2 \geq 0$**

d) Full Mathematical Formulation

Maximize $Z = 32x1 + 24x2$

Subject to:

$3x1 + 2x2 \leq 5000$ $45x1 + 40x2 \leq 84000$ $x1 \leq 1000$
$x2 \leq 1200$
$x1, x2 \geq 0$

Problem 2: Weigelt Corporation Plant Allocation

a) Decision Variables

Symbol	Meaning
x1L	Large units at Plant 1
x2L	Large units at Plant 2
x3L	Large units at Plant 3
x1M	Medium units at Plant 1
x2M	Medium units at Plant 2
x3M	Medium units at Plant 3

x1S	Small units at Plant 1
x2S	Small units at Plant 2
x3S	Small units at Plant 3

Product Data:

Size	Profit/ unit $	Storage / Unit (sq ft)	Daily Demand Cap (units)
Large (L)	**420**	**20**	**900**
Medium (M)	**360**	**15**	**1200**
Small (S)	**300**	**12**	**750**

Plant data:

Plant	Excess Capacity (units/day)	Storage Available (sq ft/day)
1	750	13000
2	900	12000
3	450	5000

b) Objective Function

Maximize daily profit:

$$Z = 420(x1L+x2L+x3L) + 360(x1M+x2M+x3M) + 300(x1S+x2S+x3S)$$

c) Constraints

Constraint Group	Constraint
Plant capacity (P1)	$x1L + x1M + x1S \leq 750$
Plant capacity (P2)	$x2L + x2M + x2S \leq 900$
Plant capacity (P3)	$x3L + x3M + x3S \leq 450$

Constraint Group	Constraint
Storage (P1)	**20x1L + 15x1M + 12x1S ≤ 13000**
Storage (P2)	**20x2L + 15x2M + 12x2S ≤ 12000**
Storage (P3)	**20x3L + 15x3M + 12x3S ≤ 5000**

Constraint Group	Constraint
Demand (L)	**x1L + x2L + x3L ≤ 900**
Demand (M)	**x1M + x2M + x3M ≤ 1200**
Demand (S)	**x1S + x2S + x3S ≤ 750**

Constraint Group	Constraint
Equal % capacity use	**(x1L+x1M+x1S)/750 = (x2L+x2M+x2S)/900 = (x3L+x3M+x3S)/450**

Constraint Group	Constraint
Non-negativity	**xij ≥ 0 for all i E {1,2,3}, j E {L,M,S}**

d) Full Mathematical Formulation

Maximize Z = 420(x1L+x2L+x3L) + 360(x1M+x2M+x3M) + 300(x1S+x2S+x3S)

with taking into consideration all the constraints.