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Quantitative Management Modeling

Assignment – Module 2

1) Say x denote collegiate backpacks and y is mini backpacks

a) The decision variables are

	x	y	Total available
Unit profit	\$32	\$24	
Nylon (sq.ft)	3	2	5400
Labor (hrs)	0.75	0.667	1400
Sales forecast	1000	1200	

b) The goal is to produce backpacks and maximize profits

Total profit $Z = \$32x + 24y$ is the object function

Say if 10 units are produced

$\$32(10) + \$24(10) = \$560$

c) Constraints are the limited resources available for fabric & labor hours

Total fabric $F = 3x + 2y \leq 5400$ sq.ft

$F = 3(10) + 2(10) = 50$ and

Total hours $L = 0.75x + 0.667y \leq 1400$ hours

$L = 0.75(10) + 0.667(10) = 14.17$

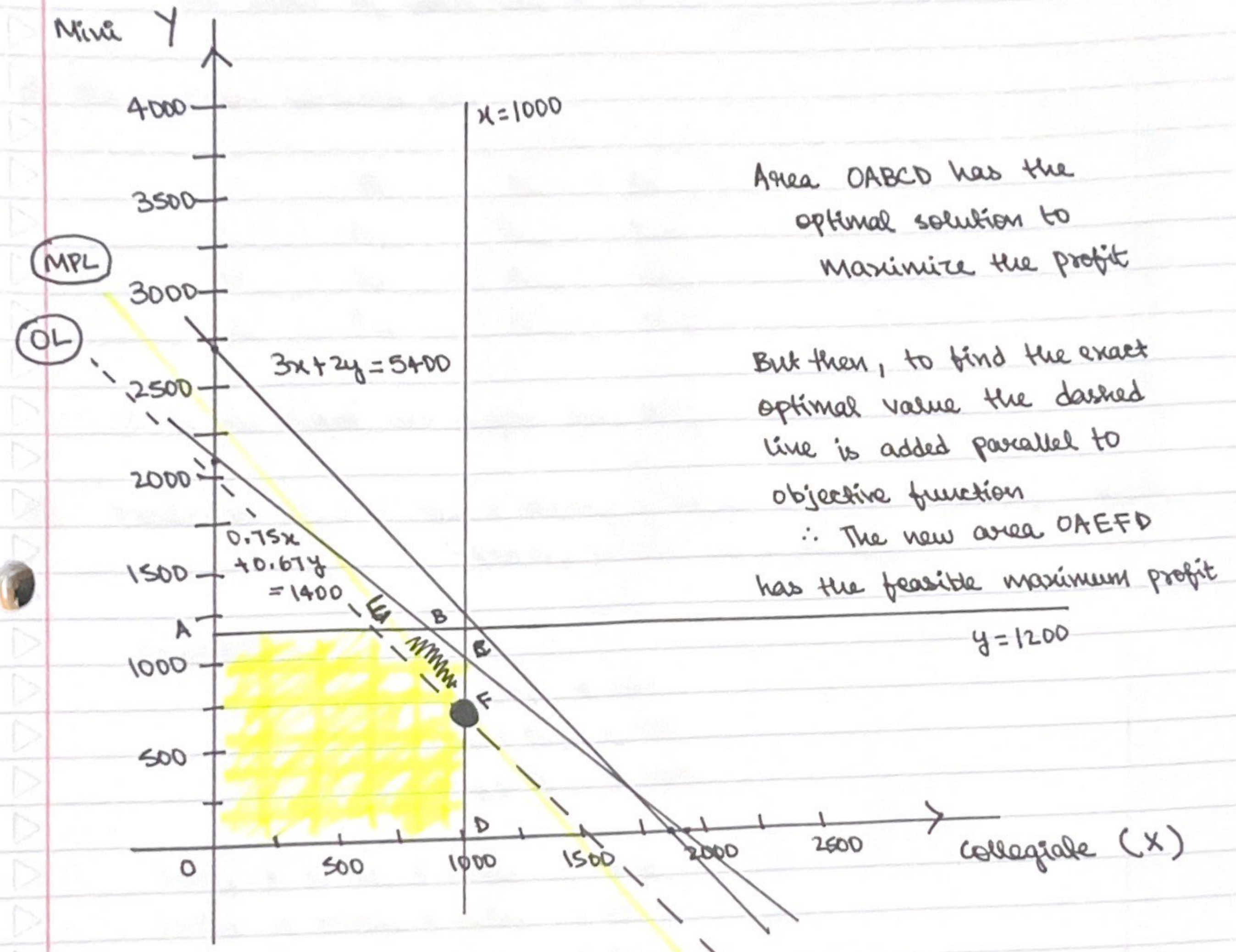
Now, units produced $\leq$ sales forecast

$x \leq 1000$

$y \leq 1200$

$x \geq 0$ and $y \geq 0$

d) solving this formulation using a graphical method



→ say, the objective function \$48,000 under the objective line (OL)

$\$ 32x + 24y = 48000$

This makes MPL the maximum profit line giving us the co-ordinates

$(x, y) = (1000, 975)$

∴ The maximum profit is produced with 1000 x bags & 975 y bags

$\$ 32x + 24y = 55,400$

2) Say there are 3 plants ; P1, P2, P3
the sizes of units are S, M, L

a) The decision variables are —

	P_1	P_2	P_3
S	P_{S1}	P_{S2}	P_{S3}
M	P_{M1}	P_{M2}	P_{M3}
L	P_{L1}	P_{L2}	P_{L3}

Z is the total net profit per day

b) Maximize $Z = 420P_{L1} + 360P_{M1} + 300P_{S1} + 420P_{L2} + 360P_{M2} + 300P_{S2} + 420P_{L3} + 360P_{M3} + 300P_{S3}$

Constraints

$$P_{L1} + P_{M1} + P_{S1} \leq 750$$
$$P_{L2} + P_{M2} + P_{S2} \leq 900$$
$$P_{L3} + P_{M3} + P_{S3} \leq 450$$

$$20P_{L1} + 15P_{M1} + 12P_{S1} \leq 13000$$
$$20P_{L2} + 15P_{M2} + 12P_{S2} \leq 12000$$
$$20P_{L3} + 15M_3 + 12P_{S3} \leq 5000$$

$$P_{L1} + P_{L2} + P_{L3} \leq 900$$
$$P_{M1} + P_{M2} + P_{M3} \leq 1200$$
$$P_{S1} + P_{S2} + P_{S3} \leq 750$$

$$1/750\,(P_{L1} + P_{M1} + P_{S1}) - 1/900\,(P_{L2} + P_{M2} + P_{S2}) = 0$$
$$1/750\,(P_{L1} + P_{M1} + P_{S1}) - 1/450\,(P_{L3} + P_{M3} + P_{S3}) = 0$$

and $P_{L1} \geq 0$ $P_{L2} \geq 0$ $P_{L3} \geq 0$

$P_{M1} \geq 0$ $P_{M2} \geq 0$ $P_{M3} \geq 0$

$P_{S1} \geq 0$ $P_{S2} \geq 0$ $P_{S3} \geq 0$

We can say the best equality constraint is redundant

$$1/900\,(P_{L2} + P_{M2} + P_{S2}) - 1/450\,(P_{L3} + P_{M3} + P_{S3}) = 0$$