

## Answer on Question #86113 – Math – Other

### Question

A company produces three products P1, P2 and P3, from three raw materials A, B and C. One unit of product P1 requires one unit of A, 3 units of B and 2 units of C. A unit of product P2 requires two units each of A and B and 3 units of C, while one unit of P3 needs 2 units of A, 6 units of B and 4 units of C. The company has a daily availability of 8 units of A, 12 units of B and 12 units of C.

It is further known that the profit per unit is Rs.3, Rs.2 and Rs.5 for P1, P2 and P3, respectively. How many units of product P1, product P2 and product P3 should the company manufacture to maximize the profit? Formulate this problem as a Linear programming problem.

### Solution

Let  $X_1, X_2$  and  $X_3$  be the quantities of P1, P2 and P3, respectively.

The LP

$$\text{Maximize } p = 3X_1 + 2X_2 + 5X_3$$

Subject to

$$X_1 + 2X_2 + 2X_3 \leq 8$$

$$3X_1 + 2X_2 + 6X_3 \leq 12$$

$$2X_1 + 3X_2 + 4X_3 \leq 12$$

$$X_1, X_2, X_3 \geq 0$$

$$\text{Maximize } p = 3X_1 + 2X_2 + 5X_3$$

Subject to

$$X_1 + 2X_2 + 2X_3 + s_1 = 8$$

$$3X_1 + 2X_2 + 6X_3 + s_2 = 12$$

$$2X_1 + 3X_2 + 4X_3 + s_3 = 12$$

$$X_1, X_2, X_3, s_1, s_2, s_3 \geq 0$$

$$-3X_1 - 2X_2 - 5X_3 + p = 0$$

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	1	2	2	1	0	0	0	8
$s_2$	3	2	6	0	1	0	0	12
$s_3$	2	3	4	0	0	1	0	12
$p$	-3	-2	-5	0	0	0	1	0

Pivot is 6

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	1	2	2	1	0	0	0	8
$s_2$	1/2	1/3	1	0	1/6	0	0	2
$s_3$	2	3	4	0	0	1	0	12
$p$	-3	-2	-5	0	0	0	1	0

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	0	4/3	0	1	-1/3	0	0	4
$s_2$	1/2	1/3	1	0	1/6	0	0	2
$s_3$	0	5/3	0	0	-2/3	1	0	4
$p$	-1/2	-1/3	0	0	5/6	0	1	10

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	0	4/3	0	1	-1/3	0	0	4
$X_3$	1/2	1/3	1	0	1/6	0	0	2
$s_3$	0	5/3	0	0	-2/3	1	0	4
$p$	-1/2	-1/3	0	0	5/6	0	1	10

Pivot is 1/2

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	0	4/3	0	1	-1/3	0	0	4
$X_1$	1	2/3	2	0	1/3	0	0	4
$s_3$	0	5/3	0	0	-2/3	1	0	4
$p$	-1/2	-1/3	0	0	5/6	0	1	10

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	0	4/3	0	1	-1/3	0	0	4
$X_1$	1	2/3	2	0	1/3	0	0	4
$s_3$	0	5/3	0	0	-2/3	1	0	4
$p$	0	0	2	0	2	0	2	24

	$X_1$	$X_2$	$X_3$	$s_1$	$s_2$	$s_3$	$p$	
$s_1$	0	4/3	0	1	-1/3	0	0	4
$X_1$	1	2/3	2	0	1/3	0	0	4
$s_3$	0	5/3	0	0	-2/3	1	0	4
$p$	0	0	1	0	1	0	1	12

The maximum profit is 12:

$$X_1 = 4, X_2 = 0, X_3 = 0$$