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Question: Wild West produces two types of cowboy hats. A type 1 hat requires three times as much labor time as a type 2. If the all available labor time is dedicated to Type 2 alone, the company can produce a total of 450 Type 2 hats a day. The market limits for the two types are 100 and 300 hats per day for Type 1 and Type 2. The profit is $8 per Type 1 and $5 per Type 2. Determine the # of hats of each type that would maximize profit.

① Build the mathematical model of the problem.

Decision variables: x_1 : type 1 produced in a day.
x_2 : type 2 produced in a day.

Constraints:

$z = 8x_1 + 5x_2$ → Maximization function.

* In terms of labour force:

$3x_1 + x_2 \leq 450$ → Labor force for producing.

* $x_1 \leq 100$, $x_2 \leq 300$ } Market limits

* $x_1 \geqslant 0$, $x_2 \geqslant 0$ } Non-negativity constraints.

→ Rewrite the equations:

1 * $3x_1 + x_2 \leq 450$ (Labor force) → ($x_1 = 150$, $x_2 = 450$)

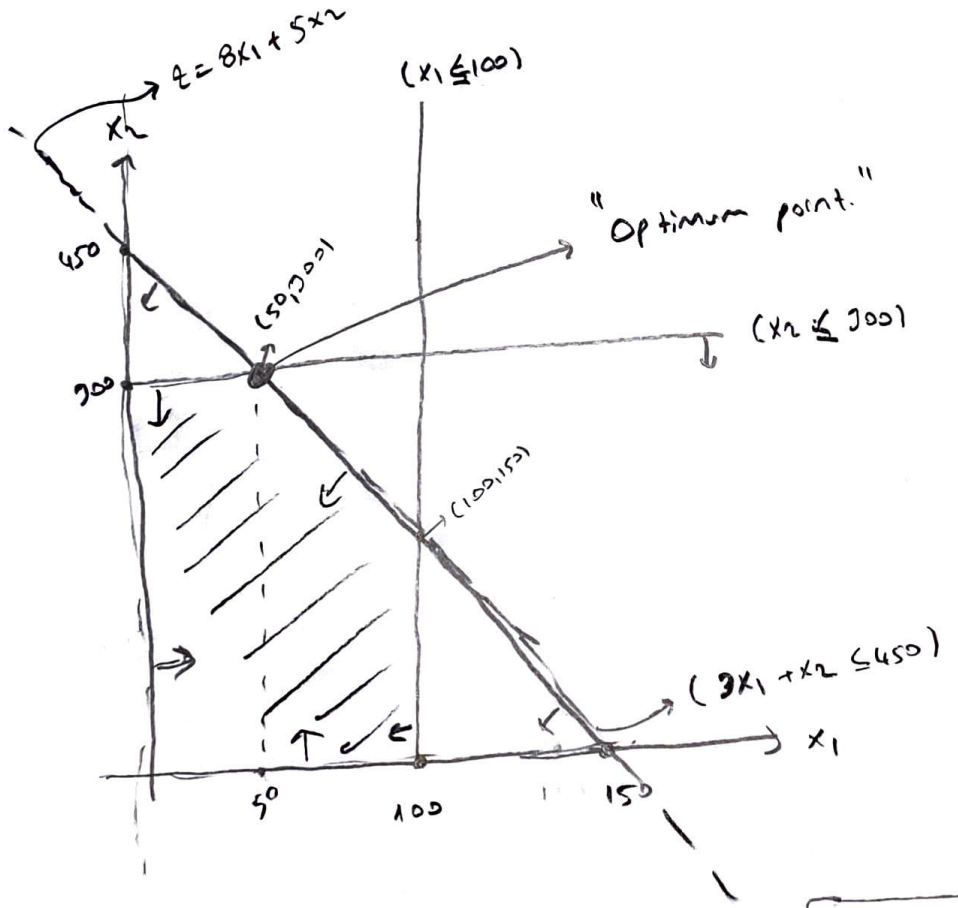
2 * $x_1 \leq 100$ (Market stock for Type 1 Hat) ($x_1 = 100$)

3 * $x_2 \leq 300$ (Market stock for Type 2 Hat) ($x_2 = 300$)

4 * $x_1 \geq 0$
5 * $x_2 \geq 0$ (Non-negativity for the products)

6 * $z = 8x_1 + 5x_2$ (Maximization function)

(2) Solve the problem graphically.



(*) In the optimum point,

$x_1 = 50$
$x_2 = 300$
$z = 1900$

The maximization function is:

$1900 = 8x_1 + 5x_2$

(*) The producer should produce 50 type 1 hat and 300 type 2 hat in order to maximize the company's profit.