# Comp 360 A1

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# Problem

A steel factory produces both raw steel and refined products. The refined products the factory produces include staples, nails, and screws. Each day the factory must guarantee a production of at least 80 staples, 25 nails, and 20 screws. In addition to this the factory produces each of its refined products in three grades; poor, average, and premium.

| Product | Grade | Cost | Value |
|---------|---------|------|-------|
| Staple | Poor | 10 | 15 |
| Staple | Average | 15 | 25 |
| Staple | Premium | 25 | 40 |
| Nail | Poor | 15 | 20 |
| Nail | Average | 25 | 40 |
| Nail | Premium | 30 | 50 |
| Screw | Poor | 70 | 80 |
| Screw | Average | 100 | 110 |
| Screw | Premium | 115 | 130 |

The factory is willing to use 1000 worth of their raw steel in order to create their premium products. Additionally, The company is running a promotion at this time and with every 10 average items sold, 1 free premium item will be given to the costumer. How much of each product must be sold to maximize the companies revenue?

# Part I

## Variables

- Staple-poor = $x_1$
- Staple-average = $x_2$
- Staple-premium = $x_3$
- Nail-poor = $x_4$
- Nail-average = $x_5$
- Nail-premium = $x_6$
- Screw-poor = $x_7$
- Screw-average = $x_8$
- Screw-premium = $x_9$

## Objective

Maximize:

$15x_1 + 25x_2 + 40x_3 + 20x_4 + 40x_5 + 50x_6 + 80x_7 + 110x_8 + 130x_9$

## Subject To

$10x_1 + 15x_2 + 25x_3 + 15_4 + 25x_5 + 30x_6 + 70x_7 + 100x_8 + 115x_9 \leq 5000,$
$x_1 + x_2 + x_3 \geq 80,$
$x_4 + x_5 + x_6 \geq 25,$
$x_7 + x_8 + x_9 \geq 20,$
$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 \geq 0,$
$-10x_2 + x_3 \geq 0,$
$-10x_5 + x_6 \geq 0,$
$-10x_8 + x_9 \geq 0,$

# Part II

## Objective

Maximize:
$15x_1 + 25x_2 + 40x_3 + 20x_4 + 40x_5 + 50x_6 + 80x_7 + 110x_8 + 130x_9$

## Subject To

$10x_1 + 15x_2 + 25x_3 + 15_4 + 25x_5 + 30x_6 + 70x_7 + 100x_8 + 115x_9 \leq 4500$
$x_1 + x_2 + x_3 \geq 80,$
$x_4 + x_5 + x_6 \geq 25,$
$x_7 + x_8 + x_9 \geq 20,$
$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 \geq 0,$
$-10x_2 + x_3 \geq 0,$
$-10x_5 + x_6 \geq 0,$
$-10x_8 + x_9 \geq 0,$

## Solution

$x_1 = 0$
$x_2 = 140$
$x_3 = 15$
$x_4 = 3$
$x_5 = 20$
$x_6 = 2$
$x_7 = 20$
$x_8 = 0$
$x_9 = 0$
$z = 6660$