

EXAMPLE 5.1: TOP BRASS TROPHY

As usual, it will help to have a tiny example at hand. We illustrate with the case of the (fictional) Top Brass Trophy Company, which makes large championship trophies for youth athletic leagues. At the moment they are planning production for two sports: football and soccer. Each football trophy has a wood base, an engraved plaque, a large brass football on top, and returns \$12 in profit. Soccer trophies are similar except that a brass soccer ball is on top, and the unit profit is only \$9. Since the football has an asymmetric shape, its base requires 4 board feet of wood; the soccer base requires only 2 board feet. At the moment there are 1000 brass footballs in stock, 1500 soccer balls, 1750 plaques, and 4800 board feet of wood. What trophies should be produced from these supplies to maximize total profit assuming that all that are made can be sold?

The decisions to be made in this problem are

$x_1 \triangleq$ number of football trophies to produce

$x_2 \triangleq$ number of soccer trophies to produce

In terms of these decision variables, we can model the problem

$$\begin{aligned}
 \max \quad & 12x_1 + 9x_2 && \text{(profit)} \\
 \text{s.t.} \quad & x_1 &\leq 1000 & \text{(footballs)} \\
 & x_2 &\leq 1500 & \text{(soccer balls)} \\
 & x_1 + x_2 &\leq 1750 & \text{(plaques)} \\
 & 4x_1 + 2x_2 &\leq 4800 & \text{(wood)} \\
 & x_1, x_2 &\geq 0 &
 \end{aligned} \tag{5.1}$$

The objective seeks to maximize total profit, and the main constraints enforce limits on footballs, soccer balls, plaques, and wood, respectively.

Figure 5.1 solves the problem graphically. An optimal solution occurs at $x_1^* = 650$ and $x_2^* = 1100$ with a total profit of \$17,700.

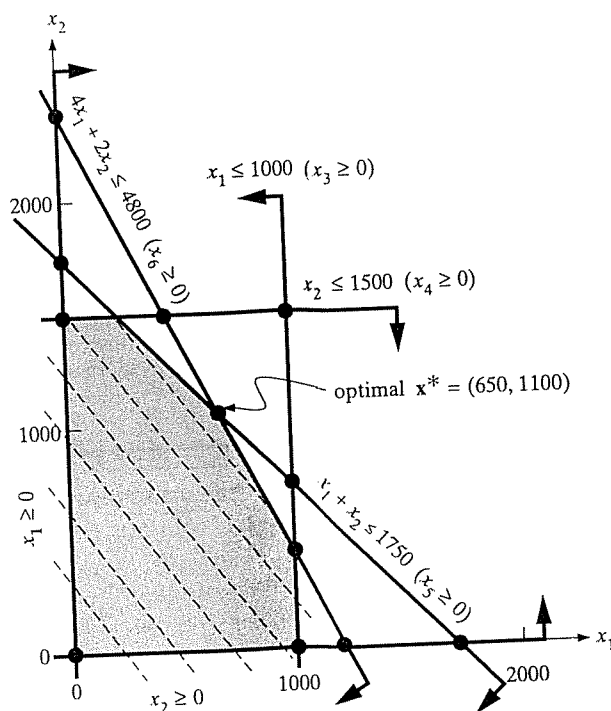


FIGURE 5.1 Graphical Solution of the Top Brass Trophy Example

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variables x1 'Number of Football trophies',
          x2 'Number of Soccer trophies',
          profit;

equations wood,plaques,footballs,soccerballs,obj;

wood..
    4*x1 + 2*x2 =l= 4800;

plaques..
    x1 + x2 =l= 1750;

footballs..
    x1 =l= 1000;

soccerballs..
    x2 =l= 1500;

obj..
    profit =e= 12*x1 + 9*x2;

model topbrass /wood,plaques,footballs,soccerballs,obj/;

solve topbrass using lp maximizing profit;
```