

## Inequalities

**What you should know**

What an inequality such as  $2x + y \leq 6$  means.

How to draw a graph to show the inequality  $2x + y \leq 6$ .

**New idea**

If you have a number of inequalities representing real situations you can draw them on a graph and shade the areas you *don't* want. The unshaded area will then be the set of solutions to the inequalities, known as the **feasible region**.

**Task: Linear programming**

A company makes two types of garden shed, standard and luxury. Use  $x$  to represent the number of standard sheds and  $y$  to represent the number of luxury sheds.

Type	Standard ( $x$ )	Luxury ( $y$ )	Total available (per day)
Machine time	2	3	30
Craftsman time	5	5	60
Profit	£60	£84	$P$

- The inequalities that represent this are  $2x + 3y \leq 30$ ,  $5x + 5y \leq 60$ ,  $x \geq 0$  and  $y \geq 0$ . Explain in words related to the problem what these inequalities represent.
- Draw the inequalities  $2x + 3y \leq 30$  and  $5x + 5y \leq 60$  on a graph. Shade the areas you *don't* want. Also shade the area to the left of the  $y$ -axis and below the  $x$ -axis (to represent  $x \geq 0$  and  $y \geq 0$ ).
- The feasible region should have four vertices:  $(0, 0)$ ,  $(12, 0)$ ,  $(0, 10)$  and the point where  $2x + 3y = 30$  and  $5x + 5y = 60$  intersect. Find where these lines intersect.
- Enter these values for  $x$  and  $y$  into a copy of the table and complete the final row.

$x$	0	12	0	
$y$	0	0	10	
$P (= 60x + 84y)$				

- Why does  $60x + 84y$  represent the profit? How many sheds of each type should the company make? What will the profit be?

**Take it further**

- Investigate how changing the amount of machine time or craftsman time alters the solution.
- The company decide the sheds need to be painted. Standard sheds take 1 hour to paint; luxury sheds takes 2 hours to paint. The company has 14 hours of painter time available each day. Investigate how adding this extra constraint into the original problem affects the solution.

**Where this goes next**

At A level this process, known as **linear programming** is studied in detail in Decision Mathematics.