

Which is easier to solve?

$$(x - 5)^2 + 4(x - 5) - 12 = 0 \quad \text{or} \quad m^2 + 4m - 12 = 0 ?$$

If a variable never appears by itself, but always appears in combinations with the same “buddies,” it may be helpful to make a substitution.

In our example,  $x$  never appears by itself – it is always in the combination  $x - 5$ . This equation is a great candidate for substitution!

**Step 1** – Set up the substitution with a single different variable

Let's make  $m = x - 5$ .

**Step 2** – Make the substitution

$$(x - 5)^2 + 4(x - 5) - 12 = 0$$

$$\swarrow \quad \searrow$$

$$m^2 + 4m - 12 = 0$$

**Step 3** – Solve the new equation. Note any multiple roots

$$m^2 + 4m - 12 = 0$$

$$(m + 6)(m - 2) = 0$$

$$m + 6 = 0 \quad m - 2 = 0$$

$$m = -6 \quad m = 2$$

$$m = -6, 2$$

(no multiple roots)

**Step 4** – Use these answers to solve for the original variable

$$m = x - 5$$

$$-6 = x - 5$$

$$-1 = x$$

$$2 = x - 5$$

$$7 = x$$

**Step 5**- Write the solution

$$x = -1, 7$$