

Solving Systems: Substitution Method

The *substitution method* is a way to solve a system of two equations algebraically. Its steps are:

- Solve **one** of the equations for **either** x or y (your choice of which equation and which variable — try to choose whichever solving is going to be easiest).
- Take the result of the solving, and **substitute** into the other equation.
- You should now have a one-variable equation. Solve for that variable.
- Use one of the original equations, put in the just-found number for one variable, and solve for the other variable.

Example

Solve the linear system.

$$\begin{array}{rcl} x + y = 1 & & \text{Equation 1} \\ 2x - 3y = 12 & & \text{Equation 2} \end{array}$$

SOLUTION

Solve for y in Equation 1.

$$y = -x + 1 \quad \text{Revised Equation 1}$$

Substitute $-x + 1$ for y in Equation 2 and solve for x .

$$2x - 3y = 12 \quad \text{Write Equation 2.}$$

$$2x - 3(-x + 1) = 12 \quad \text{Substitute } -x + 1 \text{ for } y.$$

$$2x + 3x - 3 = 12 \quad \text{Distribute the } -3.$$

$$5x - 3 = 12 \quad \text{Simplify.}$$

$$5x = 15 \quad \text{Add 3 to each side.}$$

$$x = 3 \quad \text{Solve for } x.$$

To find the value of y , substitute 3 for x in the revised Equation 1.

$$y = -x + 1 \quad \text{Write revised Equation 1.}$$

$$y = -3 + 1 \quad \text{Substitute 3 for } x.$$

$$y = -2 \quad \text{Solve for } y.$$

The solution is $(3, -2)$.

To check your solution, verify that it makes both of the equations true.

$$\begin{array}{rcl} x + y = 1 & & 2x - 3y = 12 \\ 3 + (-2) = 1 & & 2(3) - 3(-2) = 12 \\ 1 = 1 & & 6 - (-6) = 12 \\ & & 12 = 12 \end{array}$$