

Lesson Four – Solving a System with Substitution

Substitution Method

1. Solve one of the equations for one of its variables.
2. Substitute this expression into the other equation and solve for the other variable.
3. Substitute this value into either equation and solve.
4. Check the solution in each of the original equations.

Example

Solve: $3x + 4y = 15$ ^① and $x - y = 5$ ^②

Step 1: Isolate x in the second equation

$$x - y = 5 + y$$

$$x = y + 5$$

Step 2: Substitute into the first equation. (other)

$$3x + 4y = 15$$

$$3(y + 5) + 4y = 15$$

Step 3: Solve for y .

$$3y + 15 + 4y = 15 - 15$$

$$\frac{7y}{7} = \frac{0}{7}$$

$$y = 0$$

Step 4: Substitute $y = 0$ into one of the two equations and solve for the other variable. original

$$x - y = 5$$

$$x - 0 = 5$$

$$x = 5$$

sol'n
(5, 0)

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Example 2

Solve $\frac{x}{3} + \frac{y}{6} = \frac{1}{2}$ ^① and $3x + 2y = 4$ ^②

Step 1: Get rid of the fractions in equation one by multiplying by 6.

$$6 \cdot \frac{x}{3} + 6 \cdot \frac{y}{6} = 6 \cdot \frac{1}{2}$$

$$2x + y = 3 \quad \leftarrow \text{eqn ① written in a different form}$$

Step 2: Isolate y in the first equation

$$2x + y = 3$$
$$y = \frac{-2x + 3}{1}$$

Step 3: Substitute into the second equation.

$$3x + 2y = 4$$
$$3x + 2(-2x + 3) = 4$$

Step 4: Solve for x.

$$3x - 4x + 6 = 4$$

$$\frac{-x}{-1} = \frac{-2}{-1}$$
$$x = 2$$

Step 5: Substitute $x = 2$ into one of the two equations and solve for the other variable.

$$2x + y = 3$$
$$2(2) + y = 3$$
$$4 + y = 3$$
$$y = -1$$

sol'n
(2, -1)

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Example 3

Solve the system: $0.04x - 0.6y = 40$ ^① and $x + y = 6000$ ^②

multiply by 100

solve ② for x

$$\begin{aligned} 4x - 60y &= 4000 \\ \underline{x - 15y} &= 1000 \\ -y + 6000 - 15y &= 1000 \\ -16y &= -5000 \\ \frac{-16y}{-16} &= \frac{-5000}{-16} \\ y &= 312.5 \\ x &= -y + 6000 \\ x &= -312.5 + 6000 \\ x &= 5687.5 \end{aligned}$$

reduce $\div 4$

$x = -y + 6000$

Extra Practice

Solve the system: $x + y = 8$ and $x - 3y = 4$

$$\begin{aligned} x &= -y + 8 \\ -y + 8 - 3y &= 4 \\ -4y &= -4 \\ \frac{-4y}{-4} &= \frac{-4}{-4} \\ y &= 1 \\ x + y &= 8 \\ x + 1 &= 8 \\ x &= 7 \end{aligned}$$

$(7, 1)$

Assignment: Pg. 425; 4, 5, 8a, 19 (a,b), 20 b