

# Lesson 4: Solving Systems of Linear Equations by Elimination

Friday, August 31, 2018 3:55 AM

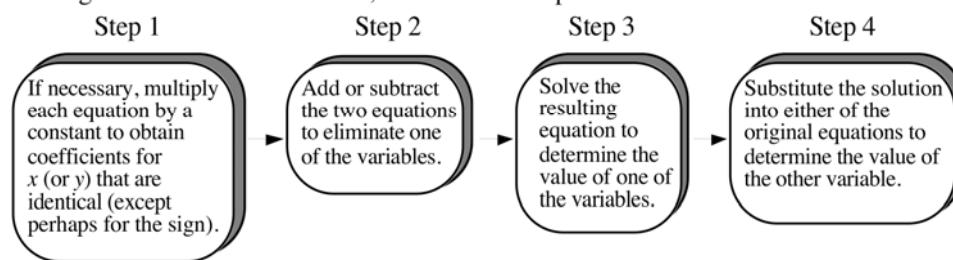
## Systems of Linear Equations Lesson #4: Solving Systems of Linear Equations by Elimination

pg. 473

So far we have used three methods to solve systems of equations: graphing, inspection, and substitution. In this lesson we will learn another algebraic technique: the method of elimination. This method is particularly useful when the equations involve fractions.

### Method of Elimination

In using the method of elimination, there are four steps which are shown below.



Consider the system of equations:

$$\begin{array}{r} 2x + 7y = 13 \\ + \quad 3x - 7y = 2 \\ \hline 5x = 15 \\ x = 3 \end{array}$$

- a) Add the two equations.  
This will eliminate the variable  $y$ .
- b) Use the equation in a) to determine the value of  $x$  and hence solve the system.
- $$\begin{array}{r} 2x + 7y = 13 \\ 2(3) + 7y = 13 \\ 6 + 7y = 13 \\ -6 \quad -6 \\ \hline 7y = 7 \\ y = 1 \end{array}$$
- c) Verify the solution satisfies both equations.
- $$\begin{array}{r} 2x + 7y = 13 \\ 2(3) + 7(1) = 13 \\ 6 + 7 = 13 \quad \checkmark \end{array}$$

$$\begin{array}{r} 3x - 7y = 2 \\ 3(3) - 7(1) = 2 \\ 9 - 7 = 2 \quad \checkmark \end{array}$$



Consider the system of equations:

$$\begin{array}{r} 2x + 6y = 6 \\ - (2x + 3y = 4.5) \\ \hline 3y = 1.5 \\ y = 0.5 \end{array}$$

- a) Subtract the two equations.  
This will eliminate the variable  $x$ .
- b) Use the equation in a) to determine the value of  $y$  and hence solve the system.
- $$\begin{array}{r} 2x + 6y = 6 \\ 2x + 6(0.5) = 6 \\ 2x + 3 = 6 \\ -3 \quad -3 \\ \hline 2x = 3 \\ x = 1.5 \end{array}$$
- c) Verify the solution satisfies both equations.
- $$\begin{array}{r} 2x + 6y = 6 \\ 2(1.5) + 6(0.5) = 6 \\ 3 + 3 = 6 \quad \checkmark \end{array}$$

$$\begin{array}{r} 2x + 3y = 4.5 \\ 2(1.5) + 3(0.5) = 4.5 \\ 3 + 1.5 = 4.5 \quad \checkmark \end{array}$$

### Complete Assignment Questions #1 - #3

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Class Ex. #3

Consider the system of equations:

$$\begin{aligned} 2x + 3y &= 4 \\ 3(4x - y &= 22) \Rightarrow 12x - 3y = 66 \end{aligned}$$

a) Does adding or subtracting the equations eliminate either of the variables? **no**

b) Multiply the second equation by 3 and then add the two equations.

$$\begin{aligned} 2x + 3y &= 4 \\ + 12x - 3y &= 66 \\ \hline 14x &= 70 \\ x &= 5 \end{aligned}$$

c) Solve and verify the system.

$$\begin{aligned} 2x + 3y &= 4 \\ 2(5) + 3y &= 4 \\ 10 + 3y &= 4 \\ 3y &= -6 \\ y &= -2 \end{aligned}$$

d) Consider the original system. Multiply the first equation by an appropriate number which will eliminate  $x$  by addition or subtraction. Solve the system.

$$6 - (-1) = 6 + 1$$

$$\begin{aligned} 2(2x + 3y &= 4) \Rightarrow 4x + 6y = 8 \\ 4x - y &= 22 \\ \hline -7y &= -14 \\ y &= 2 \end{aligned}$$

$$\begin{aligned} 2x + 3y &= 4 \\ 2x + 3(-2) &= 4 \\ 2x - 6 &= 4 \\ 2x &= 10 \\ x &= 5 \end{aligned}$$



Class Ex. #4

Consider the system of equations:

$$\begin{aligned} 7(5a + 3b &= 3) \\ 3(3a - 7b &= 81) \end{aligned}$$

a) Choose appropriate whole numbers to multiply each equation so that the system can be solved by eliminating  $b$ .b) Solve and verify the system by eliminating  $b$ .

$$\begin{aligned} 35a + 21b &= 21 \\ + 9a - 21b &= 243 \\ \hline 44a &= 264 \\ a &= 6 \end{aligned}$$

$$\begin{aligned} 5a + 3b &= 3 \\ 5(6) + 3b &= 3 \\ 30 + 3b &= 3 \\ 3b &= -27 \\ b &= -9 \end{aligned}$$

c) Choose appropriate whole numbers to multiply each equation so that the system can be solved by eliminating  $a$ .d) Solve the system by eliminating  $a$ .

$$\begin{aligned} 3(5a + 3b &= 3) \Rightarrow 15a + 9b = 9 \\ 5(3a - 7b &= 81) \Rightarrow 15a - 35b = 405 \\ \hline -44b &= -396 \\ b &= 9 \end{aligned}$$

$$\begin{aligned} 5a + 3b &= 3 \\ 5a + 3(9) &= 3 \\ 5a + 27 &= 3 \\ 5a &= -24 \\ a &= -\frac{24}{5} \end{aligned}$$



Solve the following system using elimination.

$$4x + 2y - 13 = 0,$$

$$3x = 5y + 26$$

$$\begin{aligned} 5(4x + 2y = 13) &\Rightarrow 20x + 10y = 65 \\ 2(3x - 5y = 26) &\Rightarrow 6x - 10y = 52 \\ \hline 26x &= 117 \\ x &= \frac{9}{2} = 4.5 \end{aligned}$$

$$\begin{aligned} 4x + 2y &= 13 \\ 4(4.5) + 2y &= 13 \\ 18 + 2y &= 13 \\ -18 & \\ 2y &= -5 \\ y &= -\frac{5}{2} = -2.5 \end{aligned}$$



Solve the following system using elimination.

$$\frac{x-2}{3} - \frac{y+2}{5} = 2,$$

$$\frac{3}{5}(x+1) - \frac{4}{5}(y-3) = \frac{21}{2}$$

pg. 475 # (1-5) o.l., 6-8  
WS optional extra practice

### Complete Assignment Questions #4 - #12

## Assignment

1. In each of the following systems:

- solve the system using the method of elimination by adding the equations.
- verify the solution satisfies both equations.

a)  $\begin{cases} 8x - y = 10 \\ 4x + y = 14 \end{cases}$

b)  $\begin{cases} x + 2y = 3 \\ -x + 3y = 2 \end{cases}$

c)  $\begin{cases} 4a - 3b = 2 \\ -4a - b = 6 \end{cases}$