

Name: Kelly

Guided Notes: Solving Systems by Substitution

1. Solving Systems by Substitution

- When solving by substitution, one equation must be solved for a one variable
 - This means, either x or y must be on one side of the equal sign by itself
- If your problem isn't solved for a single variable, you have to solve your equation
- Once one equation is solved for a single variable, substitute (plug) the equivalent expression in for that variable in the other equation

Example #1:

$$\begin{aligned} x + y &= 5 \\ y &= 3 + x \end{aligned}$$

Step 1: Solve an equation for one variable

Step 2: Substitute

Step 3: Solve the equation

Step 4: Plug back in to find the other variable

Solution =
 $\begin{pmatrix} 1 & 4 \end{pmatrix}$
 x y

The 2nd equation is already solved for y
 $y = 3 + x$

$$\begin{aligned} x + y &= 5 \\ x + 3 + x &= 5 \end{aligned}$$

$$\begin{aligned} x + 3 + x &= 5 \\ 2x + 3 &= 5 \\ -3 &-3 \end{aligned}$$

$$2x = 2$$

$$\begin{aligned} 2x &= 2 \\ x &= 1 \end{aligned}$$

$$\begin{aligned} y &= 3 + 1 \\ &= 4 \end{aligned}$$

Example #2:

$$\begin{aligned} x &= 3 - y \\ x + y &= 7 \end{aligned}$$

Step 1: Solve an equation for one variable.

Step 2: Substitute

The 1st equation is already solved for x
 $x = 3 - y$

$$\begin{aligned} x + y &= 7 \\ (3 - y) + y &= 7 \\ 3 &= 7 \end{aligned}$$

Step 3: Solve the equation

Does 3 = 7? NO
Because this is untrue this system has
NO SOLUTION!

Example #3:

$$\begin{aligned} 2x + y &= 4 \\ 4x + 2y &= 8 \end{aligned}$$

Step 1: Solve an equation for one variable.

It is easiest to solve the 1st equation for y
NO # in front of y.
$$\begin{array}{r} 2x + y = 4 \\ -2x - 2x \\ \hline y = -2x + 4 \\ y = -2x + 4 \end{array}$$

Step 2: Substitute

$$\begin{aligned} 4x + 2(-2x + 4) &= 8 \\ 4x - 4x + 8 &= 8 \end{aligned}$$

Step 3: Solve the equation

Does 8 = 8? yes
Because this is true this system has
Infinitely many solutions

Example #4:

Step 1: Solve an equation for one variable

$$\begin{aligned} 3y + x &= 7 \\ 4x - 2y &= 0 \end{aligned}$$

It is easiest to solve the 1st equation for x

$$\begin{aligned} 3y + x &= 7 \\ -3y &\quad -3y \\ \hline x &= -3y + 7 \\ x &= -3y + 7 \end{aligned}$$

Step 2: Substitute

$$\begin{aligned} 4x - 2y &= 0 \\ 4(-3y + 7) - 2y &= 0 \end{aligned}$$

Step 3: Solve the equation

$$\begin{aligned} 4(-3y + 7) - 2y &= 0 \\ -12y + 28 - 2y &= 0 \\ -14y + 28 &= 0 \\ -28 &\quad -28 \\ \hline -14y &= -28 \\ -14 &\quad -14 \\ \hline y &= 2 \end{aligned}$$

Step 4: Plug back in to find the other variable

$$\begin{aligned} x &= -3y + 7 \\ x &= -3(2) + 7 \\ x &= -6 + 7 \\ x &= 1 \end{aligned}$$

Solution =

(1, 2)