Solving Simultaneous Linear Equations

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Simultaneous Equations

- Simultaneous equations are as a set of equations with multiple variables that are solved together.

$$2x + y = 4$$
$$x - y = -1$$

$$2x + y - z = 9$$
$$x - y - 2z = -3$$
$$0.5x + 2y + z = 9.5$$

- The goal is to find a solution where all the equations in the system are satisfied simultaneously

Methods for Solving Simultaneous Equations

- Different methods available for solving simultaneous equations:
  - Substitution Method
  - Elimination Method
  - Graphical Method
  - Matrix Method

Method of Substitution

- Solve one of the equations for one unknown in terms of the other. Then, substitute that in the other equation. That will yield one equation in one unknown, which we can solve.

- Example: Solve the following system using the method of substitution.
  - $2x+y = 4$
  - $x-y = -1$

Method of Substitution

Example: Solve the following system using the **method of substitu**

$2x + y = 4$
$x - y = -1$

Express one variable in terms of the other in equation 1.

$2x = 4 - y$

$x = \frac{4-y}{2}$

Substitute that in equation 2.

$x - y = -1$

$\frac{4-y}{2} - y = -1$

$4 - y - 2y = -2$

$6 = 3y$

$y = 2$

Method of Substitution

Since the value of y is known (y=2), you could find the value of x by using one of the equations.

$2x + y = 4$

When y=2,

$2x + 2 = 4$

$x = 1$

Answer: $x = 1\,,\ y = 2$

Method of Elimination

Example: Solve the same system using the method of elimination.

- 2x +y = 4
- x-y = -1

- Eliminate one variable using the given two equations. For example, if the above two equations are ad eliminated.

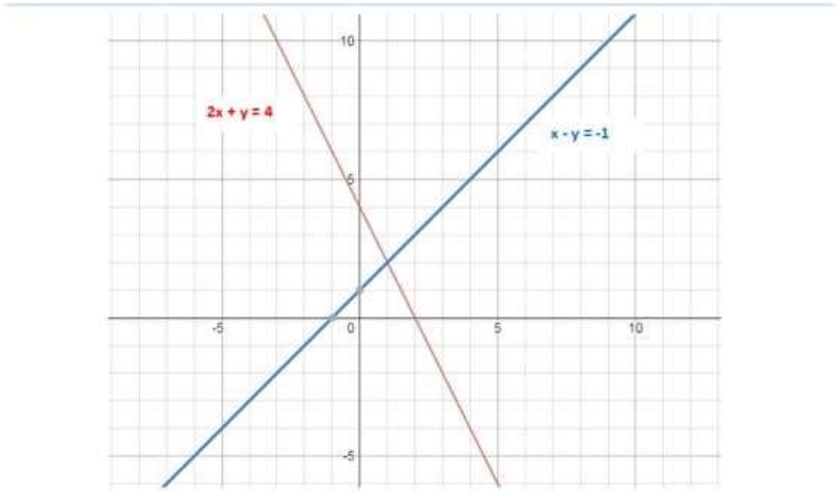
$$\begin{array}{r} 2x + y = 4 \\ x - y = -1 \\ \hline 3x = 3 \\ x = 1 \end{array} \quad \downarrow +$$

Substitute $x = 1$ in one of the equations to find y.

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

Graphical Method

- Only convenient when we have two variables.
- Plot the two linear equations (lines) on a graph paper
  - A line could be sketched by identifying the x, y intercepts. (Note: Only two points are required to plot a line)
- The solution to the system is identified by the intersection point of the above two lines (linear functions)
- Example: Solve the following system using the method of substitution.
  - $2x+y = 4$


2x + y = 4
x - y = -1
10
5
-5
0
5
10
-5