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King Saud University
1957

Linear Algebra and Vector Analysis
MATH 1120
Applied Engineering, Tutorial (1):
SOLUTION

Linear Systems with Two Variables

1- Use the Method of Substitution to find the solution to the given system

$$x - 7y = -11$$
$$5x + 2y = -18$$

Solution:

$$x - 7y = -11 \qquad \Rightarrow \qquad x = 7y - 11$$

$$5x + 2y = -18$$
$$5(7y - 11) + 2y = -18$$

$$5(7y - 11) + 2y = -18$$
$$35y - 55 + 2y = -18$$
$$37y = 37 \qquad \rightarrow \qquad y = 1$$

$$x = 7(1) - 11 = -4$$

The solution to the system is then : $\boxed{x = -4, \ y = 1}$.

2- Use the Method of Substitution to find the solution to the given system

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$$7x - 8y = -12$$
$$-4x + 2y = 3$$

$$-4x + 2y = 3$$
$$2y = 4x + 3 \qquad \Rightarrow \qquad y = 2x + \frac{3}{2}$$

$$7x - 8y = -12$$
$$7x - 8\left(2x + \frac{3}{2}\right) = -12$$

$$7x - 8\left(2x + \frac{3}{2}\right) = -12$$
$$7x - 16x - 12 = -12$$
$$-8x = 0 \qquad \rightarrow \qquad x = 0$$

$$y = 2(0) + \frac{3}{2} = \frac{3}{2}$$

The solution to the system is then : $\boxed{x = 0, \ y = \frac{3}{2}}$.

3- Use the Method of Substitution to find the solution to the given system

$$3x + 9y = -6$$
$$-4x - 12y = 8$$

Solution

$$-4x - 12y = 8$$
$$-4x = 12y + 8 \qquad \Rightarrow \qquad x = -3y - 2$$

$$3x + 9y = -6$$
$$3(-3y - 2) + 9y = -6$$

$$3(-3y - 2) + 9y = -6$$
$$-9y - 6 + 9y = -6$$
$$-6 = -6$$

Now, the result from the previous step is true for any value of y or x and so we know that the system is dependent and there will be an infinite number of solutions to the system. We can write the "solution" to this system as follows,

$$x = -3t - 2$$
$$y = t$$

t is any number

4 - Use the Method of Substitution to find the solution to the given system

$$6x - 5y = 8$$
$$-12x + 2y = 0$$

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$$6x - 5y = 8 \qquad \underset{\longrightarrow}{\times\ 2} \qquad 12x - 10y = 16$$

$$-12x + 2y = 0 \qquad \text{same} \qquad \underline{-12x + 2y = 0}$$

$$-8y = 16$$

$$y = -2 .$$

$$6x - 5(-2) = 8$$

$$6x + 10 = 8$$

$$6x = -2 \qquad \rightarrow \qquad x = -\frac{1}{3}$$

The solution to the system is then : $\boxed{x = -\frac{1}{3},\ y = -2}$.

5 - Find the solution to the following system of equations

$$2x + 5y + 2z = -38$$

$$3x - 2y + 4z = 17$$

$$-6x + y - 7z = -12$$

$$2x + 5y + 2z = -38 \qquad \underset{\longrightarrow}{\times\ 3} \qquad 6x + 15y + 6z = -114$$

$$3x - 2y + 4z = 17 \qquad \underset{\longrightarrow}{\times\ 2} \qquad 6x - 4y + 8z = 34$$

$$-6x + y - 7z = -12 \qquad \text{same} \qquad -6x + y - 7z = -12$$

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$$16y - z = -126$$
$$-3y + z = 22$$
$$-6x + y - 7z = -12$$

$$13y \quad = -104$$
$$-3y + z = 22$$
$$-6x + y - 7z = -12$$

$$y = -8.$$

We can plug $y = -8$ into the second equation and solve that for z.

$$-3(-8) + z = 22 \qquad \rightarrow \qquad z = -2$$

Finally, plug $y = -8$ and $z = -2$ into the third equation and solve for x.

$$-6x + (-8) - 7(-2) = -12$$
$$-6x + 6 = -12 \qquad \rightarrow \qquad x = 3$$

The solution to the system is then : $\boxed{x = 3, \ y = -8, \ z = -2}$.

6 - Find the solution to the following system of equations

$$3x - 9z = 33$$
$$7x - 4y - z = -15$$
$$4x + 6y + 5z = -6$$

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$3x - 9z = 33$

$3x = 9z + 33$ $\rightarrow$ $x = 3z + 11$

$7(3z + 11) - 4y - z = -15$ $\rightarrow$ $-4y + 20z = -92$

$4(3z + 11) + 6y + 5z = -6$ $6y + 17z = -50$

$-4y + 20z = -92$ $\quad \times 3$ $\quad -12y + 60z = -276$

$6y + 17z = -50$ $\quad \times 2$ $\quad \underline{12y + 34z = -100}$

$ 94z = -376$

$6y + 17(-4) = -50$ $\rightarrow$ $y = 3$

$x = 3(-4) + 11 = -1$

The solution to the system is then : $\boxed{x = -1,\ y = 3,\ z = -4}$.