Solve System of Linear Equations

This section shows you how to solve a system of linear equations using the Symbolic Math Toolbox™.

- Solve System of Linear Equations Using linsolve
- Solve System of Linear Equations Using solve

Solve System of Linear Equations Using linsolve

A system of linear equations

$$a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n = b_2$$
$$\ldots$$
$$a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n = b_m$$

can be represented as the matrix equation $A \cdot \vec{x} = \vec{b}$, where A is the coefficient matrix,

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix}$$

and $\vec{b}$ is the vector containing the right sides of equations,

$$\vec{b} = \begin{pmatrix} b_1 \\ \vdots \\ b_m \end{pmatrix}$$

If you do not have the system of linear equations in the form AX = B, use equationsToMatrix to convert the equations into this form. Consider the following system.

$$2x + y + z = 2$$
$$-x + y - z = 3$$
$$x + 2y + 3z = -10$$

Declare the system of equations.

```
syms x y z
eqn1 = 2*x + y + z == 2;
eqn2 = -x + y - z == 3;
eqn3 = x + 2*y + 3*z == -10;
```

Use equationsToMatrix to convert the equations into the form AX = B. The second input to equationsToMatrix specifies the independent variables in the equations.

```
[A,B] = equationsToMatrix([eqn1, eqn2, eqn3], [x, y, z])
```

```
A =
[  2, 1,  1]
[ -1, 1, -1]
[  1, 2,  3]


B =
    2
    3
  -10
```

Use linsolve to solve AX = B for the vector of unknowns X.

```
X = linsolve(A,B)
```

```
X =
    3
```

```
    1
   -5
```

From X, $x = 3$, $y = 1$ and $z = -5$.

Solve System of Linear Equations Using solve

Use `solve` instead of `linsolve` if you have the equations in the form of expressions and not a matrix of coefficients. Consider the same system of linear equations.

$$2x + y + z = 2$$
$$-x + y - z = 3$$
$$x + 2y + 3z = -10$$

Declare the system of equations.

```
syms x y z
eqn1 = 2*x + y + z == 2;
eqn2 = -x + y - z == 3;
eqn3 = x + 2*y + 3*z == -10;
```

Solve the system of equations using `solve`. The inputs to `solve` are a vector of equations, and a vector of variables to solve the equations for.

```
sol = solve([eqn1, eqn2, eqn3], [x, y, z]);
xSol = sol.x
ySol = sol.y
zSol = sol.z
```

```
xSol =
3
ySol =
1
zSol =
-5
```

`solve` returns the solutions in a structure array. To access the solutions, index into the array.

Related Topics

- Solve Algebraic Equation
- Solve System of Algebraic Equations