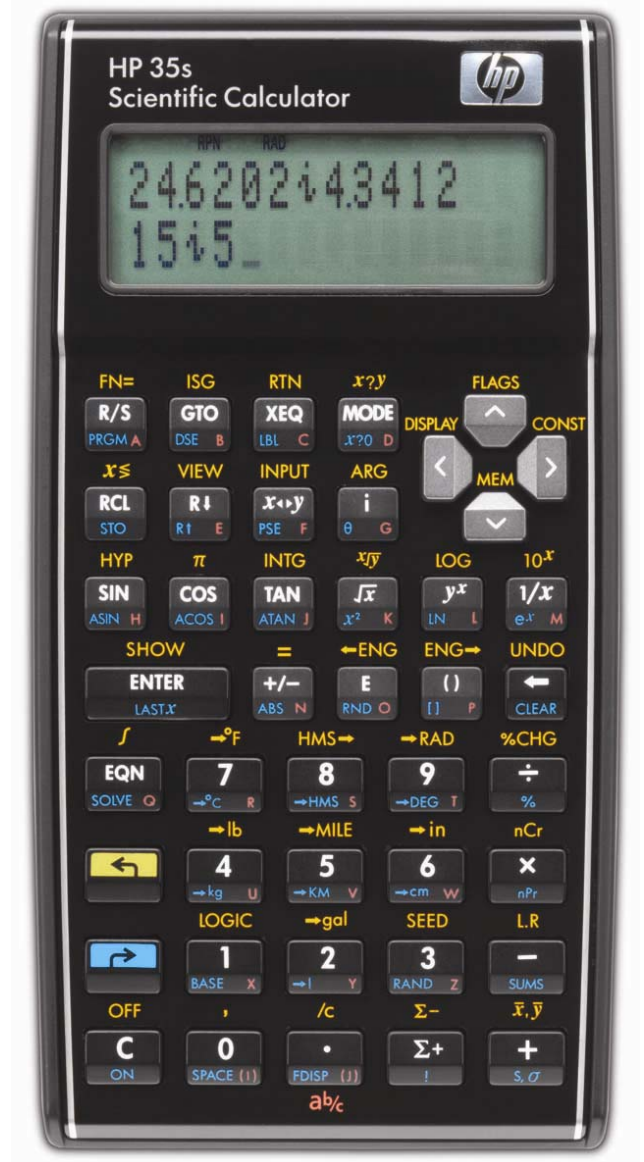# hp calculators

HP 35s Solving systems of linear equations

Systems of linear equations

Using the built-in solver equations

Practice solving linear systems

Systems of linear equations

A system of linear equations is a set of linear equations involving two or more variables. A basic problem is to determine if there are values for the variables that will allow each equation in the set to be solved so that the left side of the equation equals the right side of the equation. Linear systems appear in many applications such as forecasting, optimization, etc. Systems are often described as 2x2, 3x3, 4x4, etc., referring to the number of variables and the number of equations in the set.

An example of a 2x2 linear system might be:

$$3 X + \quad Y = 10$$
$$X - 2 Y = 8$$

which has the solution set of { X = 4, Y = -2 }. Not every system of linear equations has a solution. Other systems have an infinite number of solutions.

Using the built-in solver equations

The HP 35s two build-in solver equations to find solutions to 2x2 and 3x3 linear systems. These can detect situations where no solution exists or where an infinite number of solutions exist. These solver equations are part of the HP 35s ROM and are always present at the top of the equation list. If you press $\boxed{\text{EQN}}$, then the two equations should be visible as shown below (if you have entered equations of your own, then you may need to use the up or down cursor keys to move through the equation catalog to find them):
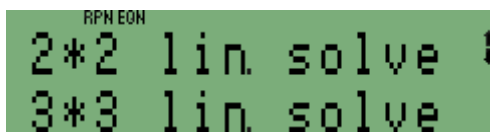

Figure 1

The equation at the bottom of the display is the one that will be solved when $\boxed{\text{◪}}$ $\boxed{\text{SOLVE}}$ is pressed.

These equations store the values from the linear system into the lettered variables/registers beginning with A. 2x2 systems require a total of 6 coefficients to be entered. In this example system,

$$3 X + \quad Y = 10$$
$$X - 2 Y = 8$$

the coefficient 3 (from the 3 X term) would be stored into A, the 1 (from the implied 1 in front of the Y term) would be stored into B, the constant 10 would be stored into C, the 1 (from the implied 1 in front of the X in the second linear equation) would be stored into D, the -2 into E, and the 8 into F.

A 3x3 system would use a total of 12 lettered variables/registers, A through L.

Practice solving linear systems

Example 1: Solve the 2x2 linear system:

$$3 X + \quad Y = 10$$
$$X - 2 Y = 8$$

HP 35s Solving systems of linear equations

Solution: In either RPN or algebraic mode, make sure the "2*2 lin. solve" equation is shown at the bottom of the equation screen and press ⬛ SOLVE equation is. The display should appear like the one below before beginning the solution by pressing ⬛ SOLVE .

```
        RPN EQN
 EQN LIST TOP   ↕
 2*2 lin. solve
```
Figure 2

```
     RPN EQN
 A?
 0.0000
```
Figure 3

The HP 35s prompts you to enter the value of the first coefficient. It displays the current contents of the A register in case you wish to use it again. If you have previously stored a value into A, it may not show 0.0000 as depicted above.

In RPN or algebraic mode: [3] [R/S]

```
        RPN EQN
 B?
 0.0000
```
Figure 4

The HP 35s now prompts for the second coefficient which it will store in B.

In RPN or algebraic mode: [1] [R/S]

Continue to enter the remaining coefficients as below.

In RPN or algebraic mode: [1] [0] [R/S]
In RPN or algebraic mode: [1] [R/S]
In RPN or algebraic mode: [2] [+/−] [R/S]
In RPN or algebraic mode: [8] [R/S]

After entering the last coefficient, the HP 35s displays the solution found beginning with X, as shown below. To view the solution for Y, press the down cursor key, [∨] .

```
     RPN
 X=             ↕
          4.0000
```
Figure 5

```
     RPN
 Y=             ↕
         ⁻2.0000
```
Figure 6

<u>Answer:</u>   The system has the solution X = 4, Y = -2.

<u>Example 2:</u> Solve the 3x3 linear system:

  4 X +   5 Y +   Z = 0
  3 X +   2 Y -   Z = 7
-1 X + 112 Y + 3 Z = 127
.

<u>Solution:</u>   In either RPN or algebraic mode, make sure the "3*3 lin. solve" equation is shown at the bottom of the equation screen and press 🔁 SOLVE equation is. The display should appear like the one below before beginning the solution by pressing 🔁 SOLVE .
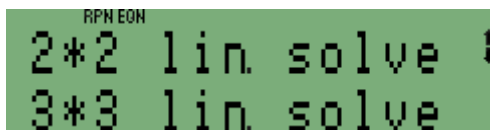

Figure 7

Figure 8

As in the previous example, key in each coefficient and press R/S. The keystrokes are the same in RPN or algebraic mode.

4 R/S	(stored into A)
5 R/S	(stored into B)
1 R/S	(stored into C)
0 R/S	(stored into D)
3 R/S	(stored into E)
2 R/S	(stored into F)
1 +/− R/S	(stored into G)
7 R/S	(stored into H)
1 +/− R/S	(stored into I)
1 1 2 R/S	(stored into J)
3 R/S	(stored into K)
1 2 7 R/S	(stored into L)

After entering the last coefficient, the HP 35s displays the solution found beginning with X, as shown below. To view the solution for Y and Z, press the down cursor key, ⌄ .

Figure 9

Figure 10

Figure 11

To view the solutions as fractions, when X, Y, and Z are displayed, press 🄿 FDISP and the results are shown as:

Figure 12

Figure 13

Figure 14

Answer: The solution to the system of linear equations is { X = -3/11, Y = 1 3/11, Z = -5 3/11 }