hp calculators

HP 49G+ Solving linear systems of equations using matrices

The Numeric Solver

Solving linear systems of equations

Practice solving linear systems

The Numeric Solver

The HP 49G+ has a numeric solver that can find the solutions to many different types of problems. It is invoked by pressing the RED shift key followed by the 7 key, or → NUM.SLV .

When pressed, the CHOOSE box below is displayed:

Figure 1

The first choice allows for the solution of an equation containing a number of unknowns. The second choice solves differential equation problems. The third choice solves for zeroes of a polynomial. The fourth choice to solve linear systems of equations is the one of interest here. The fifth choice invokes the finance solver. The sixth choice begins the multiple equation solver. To select the linear systems solver, press 4 ENTER . The 49G+ displays the following screen:

Figure 2

There are three input areas on this form. The first area is labeled A: and is where the matrix containing the coefficients of the system of linear equations are entered. The second area is labeled B: and is where the constants from the system of equations are entered. The third area is where the values of the unknown variables X in the systems of linear equations are returned when a solution is found. To enter the coefficients in a matrix, press EDIT when the cursor is beside the area labeled A: and the MatrixWriter is launched.

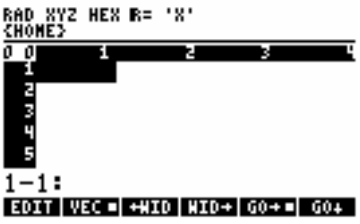

Figure 3

In many ways, this screen works like any spreadsheet. Enter numbers and they will go in the highlighted cell. The menu labels at the lower left corner of the screen, GO→ and GO↓, determine the direction the cursor moves after a data point has been entered, either right to the next column or down to the next row. In this example, the selection is to move right after each data point has been entered. This is indicated by the square present next to the GO→ menu label. To change the way the cursor will move, press the menu label for the direction desired and the square in the menu label will change accordingly. If a column is too small to show the data entered, the +WID and WID+ menu keys may be used to expand or shrink the area displayed for each column.

Enter the first coefficient from the first equation by keying in the numbers and pressing the ENTER key. The cursor will move to the right into the second column where the second coefficient should be keyed with the ENTER key pressed to accept this value. At this point, the cursor will be in column 3. If the system of linear equations being entered has more than two unknown variables, continue entering the data until done. Use the ▼ and ◀ keys to move back to the first column and enter the coefficients from the second equation. Continue entering rows of data into the matrix until done. If at any time you notice a mistake in the data, use the arrow keys

to go back to the incorrect data value, key in the correction, press the ENTER key to accept the change, and then use the arrow keys to go back to where you were. After entering a matrix, the screen would look something like this:

Figure 4

To accept the data as input, press the ENTER key and the matrix will be returned to the system of linear equations solver.

Figure 5

To enter the constants for the linear equations, press the ▼ key and press the menu label EDIT above the F1 key. The MatrixWriter will be brought up a second time to enter the constants. Note that the constants are entered as a column of numbers rather than a row. Enter the numbers the same way that the coefficients were entered.

Figure 6

When the ENTER key is pressed, the constants are returned to the linear equation system solver in the B: area, as shown below.

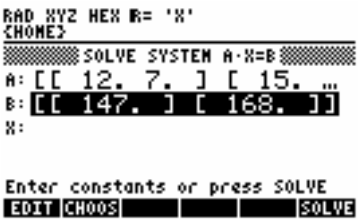

Figure 7

To solve for the values of X that make the system of linear equations work, use the arrow keys to move down to the X: area. Press the menu label SOLVE above the F6 key and the values of X_1 and X_2 that solve the linear system are returned and displayed.

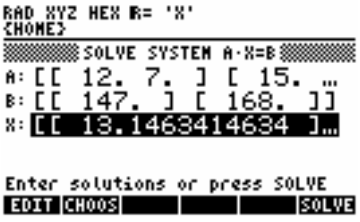

Figure 8

The solution may be seen easier by pressing EDIT above the (F1) key to view the solution in the MatrixWriter. If the columns are too small to see many significant figures, press the WIDE menu label to make them wider.

Figure 9

You may also exit to the stack and view the solutions on the first level. To exit to the stack from within the MatrixWriter, as we were immediately above, press (ENTER) (ENTER) and the display will show:

Figure 10

Solving linear systems of equations

There are many times when a problem is presented of the form:

$$5\,X_1 + 10\,X_2 + 3\,X_3 = 20$$
$$4\,X_1 + 1\,X_2 + 8\,X_3 = 15$$

and the values of X_1, X_2, and X_3 are needed. Manual methods to eliminate variables and reduce the number of unknowns used to be the only way to solve these. The 49G+ makes such solutions easy.

Practice solving linear systems

Example 1: What are the values of X_1, X_2, and X_3 that solve the following system of linear equations?

$$5\,X_1 + 10\,X_2 + 3\,X_3 = 20$$
$$4\,X_1 + 1\,X_2 + 8\,X_3 = 15$$

Solution: To solve this linear system, use the numeric solver as shown.

(↱) NUM.SLV (4) (ENTER) EDIT (5) (ENTER) (1) (0) (ENTER) (3) (ENTER) (▼) (◀) (◀) (◀)
(4) (ENTER) (1) (ENTER) (8) (ENTER)

Figure 11

(ENTER)

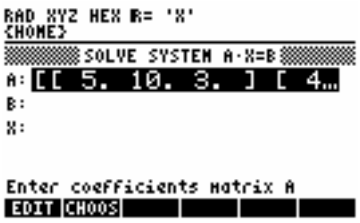

Figure 12

▼ EDIT 2 0 ENTER ▼ ◀ 1 5 ENTER

Figure 13

ENTER

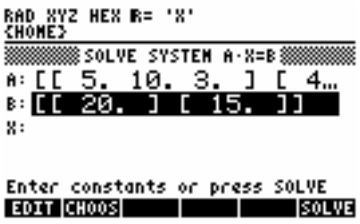

Figure 14

▼ SOLVE

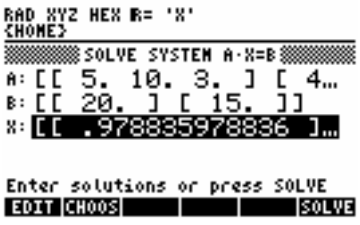

Figure 15

EDIT VEC ▼ VEC

Figure 16

ENTER ENTER

Figure 17

Answer: The value of X_1 is 0.9788, the value of X_2 is 1.1376, and the value of X_3 is 1.2434, all approximately of course.

Example 2: What are the values of X_1, X_2, and X_3 that solve the following system of linear equations?

$$3\,X_1 + 5\,X_2 + 1\,X_3 = 36$$
$$1\,X_1 + 2\,X_2 + 4\,X_3 = 42$$
$$4\,X_1 + 3\,X_2 + 2\,X_3 = 28$$

Solution: To solve this linear system, use the numeric solver as shown.

↱ NUM.SLV 4 ENTER 3 ENTER 5 ENTER 1 ENTER ▼ ◀ ◀ ◀
1 ENTER 2 ENTER 4 ENTER 4 ENTER 3 ENTER 2 ENTER

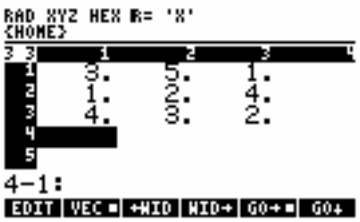

Figure 18

ENTER ▼ 3 6 ENTER 4 2 ENTER 2 8 ENTER ENTER

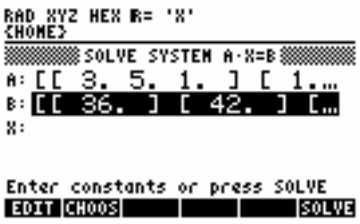

Figure 19

▼ SOLVE

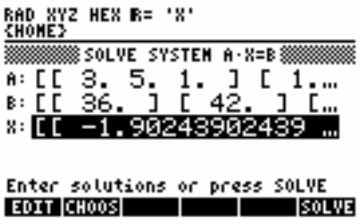

Figure 20

ENTER

Figure 21

Answer: The value of X_1 is –1.9024, the value of X_2 is 6.8293, and the value of X_3 is 7.5609, all approximately.