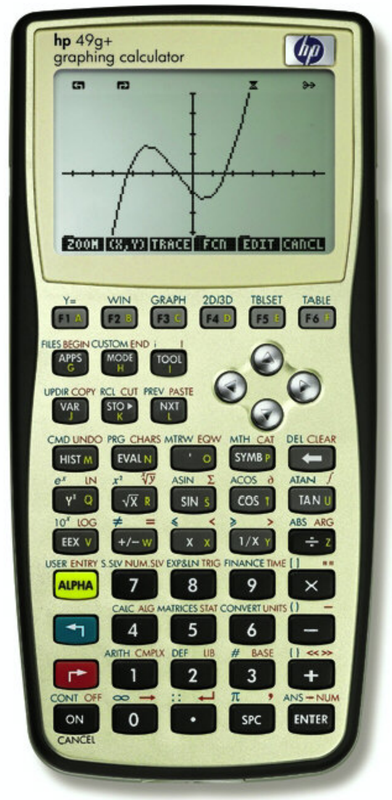
hp calculators

HP 49G+ Solving for roots of polynomials and quadratics

The Numeric Solver

Practice finding roots of polynomials and quadratics



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:

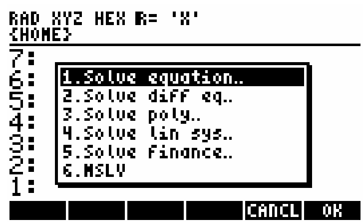


Figure 1

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 and is of interest here. The fourth choice can solve linear systems of equations for unknown values. The fifth choice invokes the finance solver. The sixth choice begins the multiple equation solver. To select the polynomial solver, press 3 ENTER . The 49G+ displays the following screen:

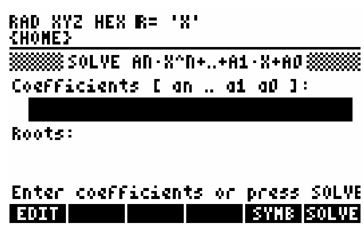


Figure 2

There is one input area on this form. This is where the polynomial coefficients are entered. If a polynomial has "missing" terms, these must be entered as zeroes in the coefficient matrix in this input area. In other words, if a polynomial is of the form

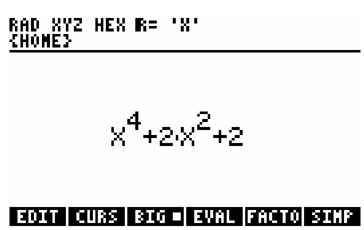


Figure 3

then the coefficients would be 1 (for the X^4 term), 0 (for the missing X^3 term), 2 (for the 2 X^2 term), 0 (for the missing X^1 term) and 2 for the final term. To enter the coefficients in a matrix, press EDIT when the cursor is under the area labeled Coefficients and the MatrixWriter is launched.

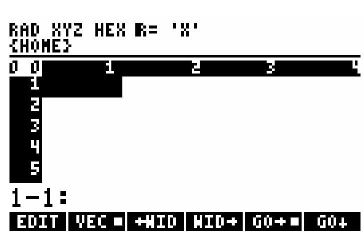


Figure 4

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 and that is what is needed to enter the polynomial coefficients in a horizontal row of the matrix. 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 term of the polynomial 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. Continue entering the coefficients of each term of the polynomial, including zeroes for any term not present in the polynomial, until the final constant term has been entered. 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:

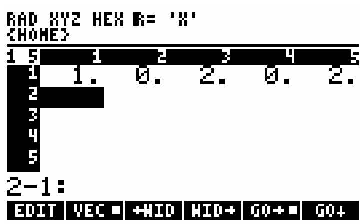


Figure 4

To accept the data as input, press the ENTER key and the matrix will be returned to polynomial root solver.

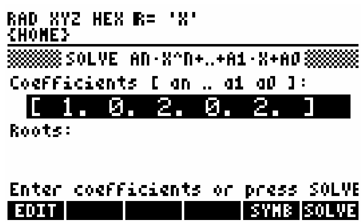


Figure 5

To solve for the roots of the polynomial, press the ▼ key and press the menu label SOLVE above the F6 key. The roots of the polynomial (which in this case are four complex numbers) will be returned and displayed as shown below.

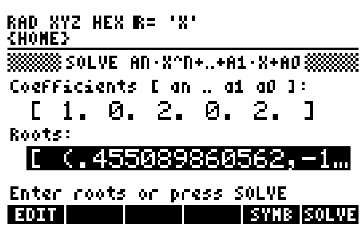


Figure 6

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 WID→ menu label to make them wider. You may also exit to the stack and view the solutions on the first level.

The polynomial solver is a powerful aid to solve these types of problems, but there are polynomials where it makes little sense to use this tool. Consider the solution to the polynomial shown below:

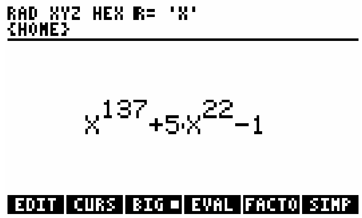


Figure 7

To solve this would require entering 137 coefficients, most of which would be zero! A better approach for this example would be to use the general equation solver (choice one from the Numeric Solver CHOOSE box). This tool is covered in another training aid.

Practice finding roots of polynomials and quadratics

<u>Example 1:</u> What are the roots of the equation below?

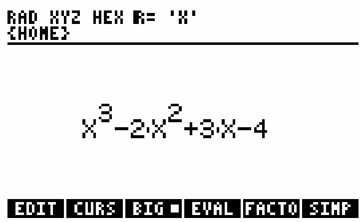


Figure 8

<u>Solution:</u> To find the roots of this polynomial, use the numeric solver as shown.

→ NUM.SLV 3 ENTER EDIT 1 ENTER 2 +/- ENTER 3 ENTER 4 +/- ENTER ENTER

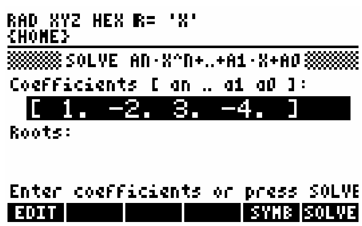


Figure 9

▼ SOLVE

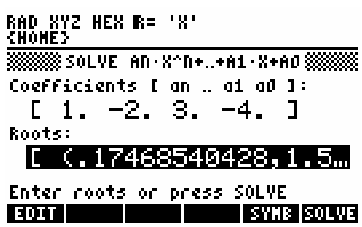


Figure 10

EDIT (the first root is in cell 1-1)

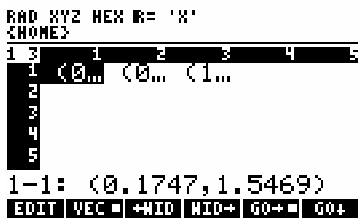


Figure 11

▶ (the second root is in cell 1-2)

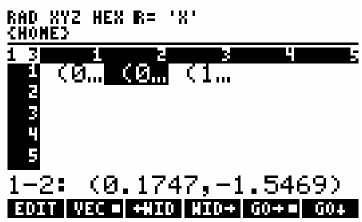


Figure 12

▶ (the third root is in cell 1-3)

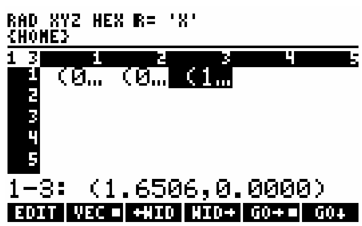


Figure 13

ENTER ENTER

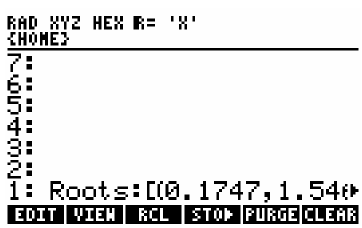


Figure 14

Answer: There are three roots to the polynomial, two of which are complex numbers and one is real. The real solution is 1.6506, while the complex solutions are (0.1747,1.5469) and (0.1747,-1.5469)

Example 2: What are the roots of the quadratic equation below?

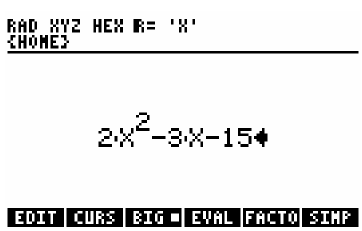


Figure 15

Solution: To find the roots of this polynomial, use the numeric solver as shown.

→ NUM.SLV 3 ENTER EDIT 2 ENTER 3 +/- ENTER 1 5 +/- ENTER ENTER

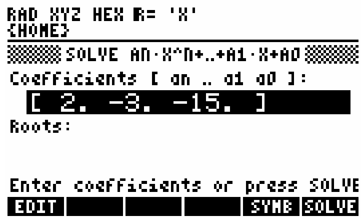


Figure 16

▼ SOLVE

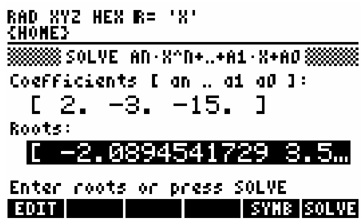


Figure 17

EDIT (the first root is in cell 1-1)

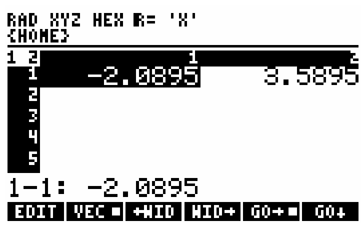


Figure 18

▶ (the second root is in cell 1-2)

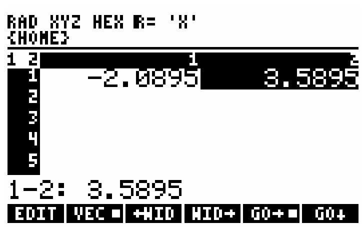


Figure 19

ENTER ENTER

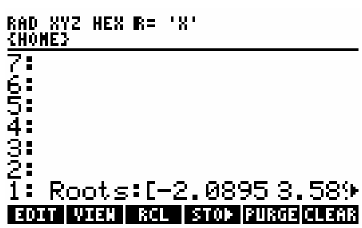


Figure 20

Answer: There are two roots to this quadratic equation, -2.0895 and 3.5895.