

Finding and accessing polynomial roots

For the hp 39gs and hp 40gs the key to this process is either the PLOT screen or the POLYROOT function.

POLYROOT([coeff1,coeff2,...])

This function returns the roots of the polynomial whose coefficients are specified. The coefficients must be input as a vector in square brackets.



Eg. Using the function $f(x) = (x-2)(x+3)(x-1) = x^3 - 7x + 6$ we can enter the coefficients as [1, 0, -7, 6].

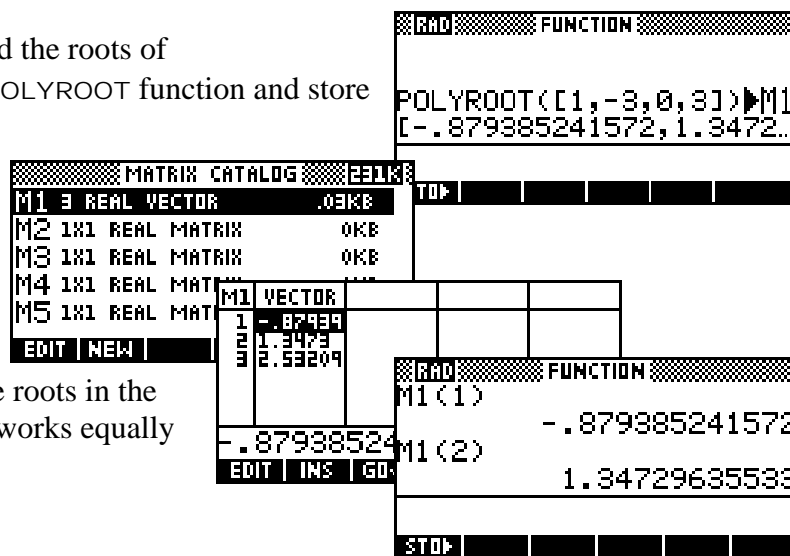
As you can see in the screen shot, the roots of 2, -3 and 1 have been correctly found.

The POLYROOT function can be used to find roots very quickly, but the results are often difficult to see in the HOME view due to the number of decimal places spilling off the edge of the screen, particularly if they include complex roots. This can be dealt with easily by storing the results to a matrix.

For example, suppose we want to find the roots of $f(x) = x^3 - 3x^2 + 3$. We will use the POLYROOT function and store the results into M1.

The advantage of this is that you can now view the roots by changing to the Matrix Catalog (SHIFT 4) and pressing **EDIT**.

In addition to this, you can access the roots in the HOME view as shown. This method works equally well for complex roots.



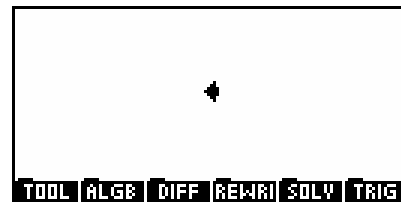
Calculator Tip

This trick is particularly helpful if you are working with complex roots. Not only does it make it easier to re-use them it makes it easier to tell at a glance which are real and which complex.

Complex Roots on the hp 40gs

- i. Find all roots of the complex polynomial $f(z) = z^3 + iz^2 - 4z - 4i$.
- ii. Find the complex roots of $z^5 = 32$.

On the hp 40gs you can obtain exact roots for polynomials using the CAS function SOLVEVX. The instructions following assume that the CAS is in its default configuration. See page **Error! Bookmark not defined.** for more details on the CAS.

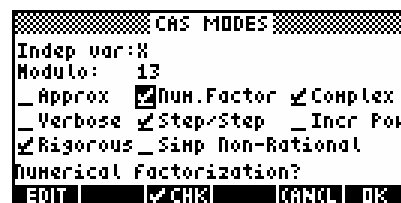


In the HOME view, press the **CAS** button to enter the CAS. Press the **SOLV** screen button to access the Solve menu. Scroll down to find SOLVEVX and press ENTER.

Type in the function using the default variable X rather than Z. Make sure you press the **X** button between the i and the X² or it will be interpreted as a variable called 'iX'² rather than as i*X². The result should be as shown right.

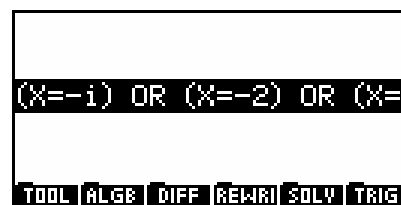


If you press ENTER at this moment then the result will probably be "NO_SOLUTION" because we need to set one of the configuration flags. Press SHIFT MODES to enter the configuration menu shown right.



In the configuration screen, move the highlight to the "Num. factor" option shown right and press **CHK** to set it. Then press **OK** to quit from the configuration menu and return to the main screen.

Now press ENTER to tell the calculator to execute the SOLVEVX command. The calculator will then ask if you want to turn "Complex Mode" on. Tell it **YES**. The final result is shown right. Pressing VIEWS will allow you to scroll right and left through the solutions.



A similar result can be found for the second equation. The calculator will ask you if you want to turn "Approximation mode" on. If you respond with **NO** then the result will be as shown right. Responding with **YES** instead will result in the second screen below right. Note that "Approx mode" will be left active and you should choose probably turn it off in the MODES view if you don't want decimal results from that point on. Note that the SINCOS function can be used to transform each exponential format solution into rcis format.

