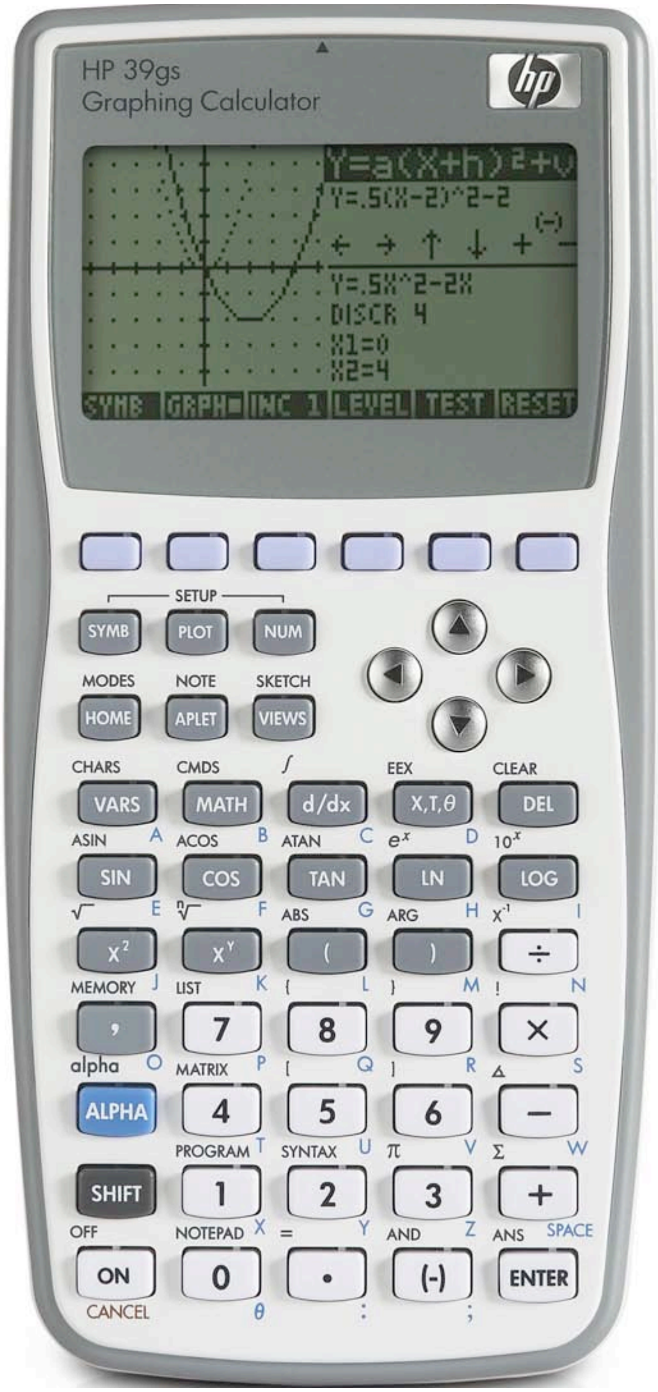
hp calculators

HP 39gs Using Matrices

How are matrices stored?

How do I solve a system of equations?

Quick and easy roots of a polynomial



How are matrices stored?

Matrices are stored and edited in the Matrix Catalog. It can hold matrices that are vectors or contain complex numbers. Once defined, a matrix or vector can be used or manipulated in any other view. Some extremely powerful matrix functions are included in the MATH menu. It can be cleared using SHIFT CLEAR.

Figure 1

Given that $A = \begin{bmatrix} 2 & 3 \\ -1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 4 \\ 2 & 3 \end{bmatrix}$, find the value of $B^{-1}A$

Enter the Matrix Catalog by pressing SHIFT MATRIX. With the highlight on M1, press EDIT. Enter the values 2 and 3, pressing ENTER after each. Press down arrow to begin a new line and enter the values –1 and 4. Leave the edit view by pressing SHIFT MATRIX again. Use the same method to create M2.

Figure 2

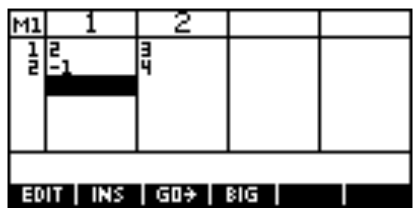


Figure 3

Now in the HOME view, perform the calculation by typing ALPHA M 2 X^{-1} * ALPHA M1. Then store the solution in M3 in case it is required later. The value displayed can be viewed more easily using SHOW.

Figure 4

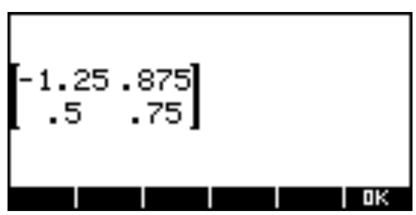


Figure 5

How do I solve a system of equations?

Systems of simultaneous linear equations of any size can be solved either with an inverse matrix or using the function RREF from the MATH menu.

The sales of type A, B and C computers for three successive weeks are shown right. Find the prices of each type of computer.

	A	B	C	Value
Week 1	2	0	4	$12,900
Week 2	3	5	0	$13,335
Week 3	1	4	2	$13,950

This system of equations can be represented in matrix form as: $\begin{bmatrix} 2 & 0 & 4 \\ 3 & 5 & 0 \\ 1 & 4 & 2 \end{bmatrix} \times \begin{bmatrix} A \\ B \\ C \end{bmatrix} = \begin{bmatrix} 12900 \\ 13335 \\ 13950 \end{bmatrix}$

If we enter the first matrix as M1 and the values as M3 then the solution is M1-1*M3.

Change to the Matrix Catalog and enter the M1 as outlined on the previous page. Before entering the values into M2, press shift key 3 to change it to GO->. This moves the cursor down instead of right after each entry.

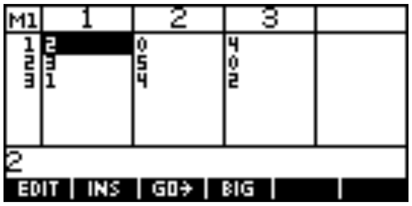


Figure 6

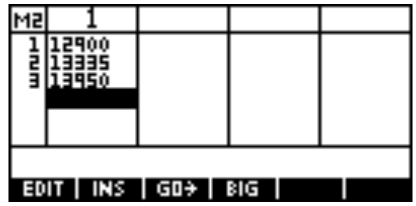


Figure 7

Rounding error may make it difficult to see the solution in the HOME view. Viewing M3 is probably the better option.

Figure 8

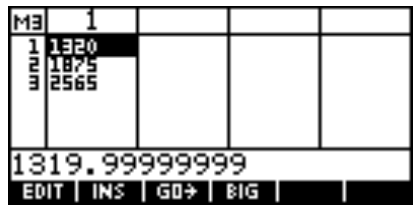


Figure 9

If there is no valid solution then the matrix inverse will not exist, as shown below.

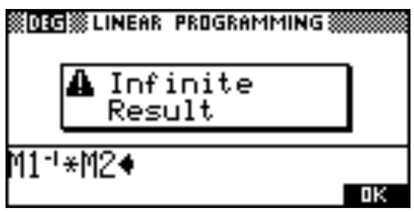
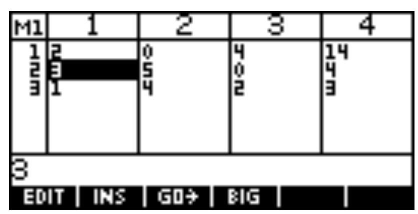


Figure 10

Here it is better to use the RREF function (Reduced Row Echelon Form). It acts on an augmented matrix and its advantage is that it will work even if the equations are inconsistent. Three cases can result, as below.

Case 1: A unique solution

$$\left.\begin{aligned} 2x+4z &= 14 \\ 3x+5y &= 4 \\ x+4y+2z &= 3 \end{aligned}\right\} \text{becomes} \left[\begin{array}{ccc|c} 2 & 0 & 4 & 14 \\ 3 & 5 & 0 & 4 \\ 1 & 4 & 2 & 3 \end{array}\right]$$



The final column of the matrix contains the solution.

Figure 11

Figure 12

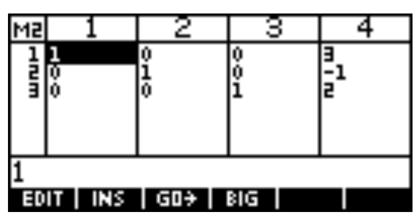


Figure 13

Case 2: No solution

$$\left.\begin{aligned} 2x + y - z &= 2 \\ 3x + 5y &= -1 \\ x + 4y + z &= 3 \end{aligned}\right\} \text{ becomes } \left[\begin{array}{ccc|c} 2 & 1 & -1 & 2 \\ 3 & 5 & 0 & -1 \\ 1 & 4 & 1 & 3 \end{array}\right]$$

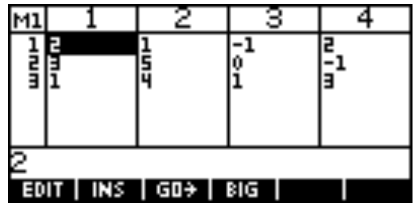


Figure 14

In this case the final line of the reduced row echelon matrix is [0 0 0 1], hence no solution.

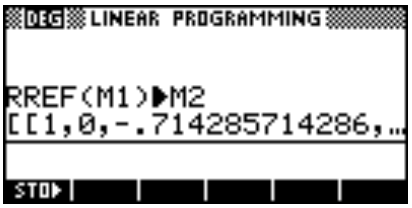


Figure 15

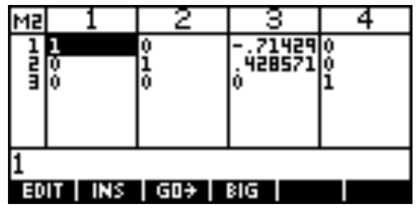


Figure 16

Case 3: Infinite solutions

This case is similar to that of no solution but the final line of the reduced row echelon matrix will be [0 0 0 0], which corresponds to the case of infinite solutions.

Quick and easy roots of a polynomial

Although it is possible to find roots of any graph by using the PLOT view and FCN, the MATH menu provides a function called POLYROOT which will find all the roots of any polynomial in one operation.

Find the roots of $f(x) = x^4 - 27x^2 - 14x + 135$.

Figure 17

Coefficients must be supplied in the form of a row vector using square brackets and solutions are returned the same form. If any of the roots are complex then the entire set will be returned in complex form (a,b) as in the example below.

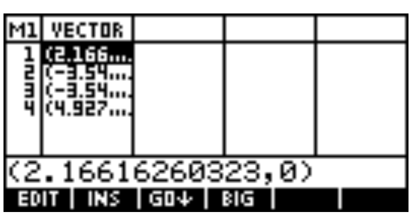


Figure 18

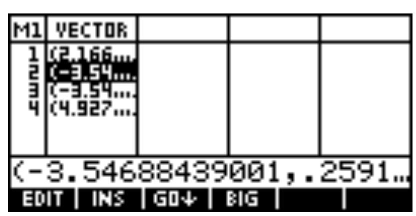


Figure 19

Note: A worthwhile tip here is to store the solution vector into a matrix variable. This allows easy viewing of the solutions, both real and complex.