

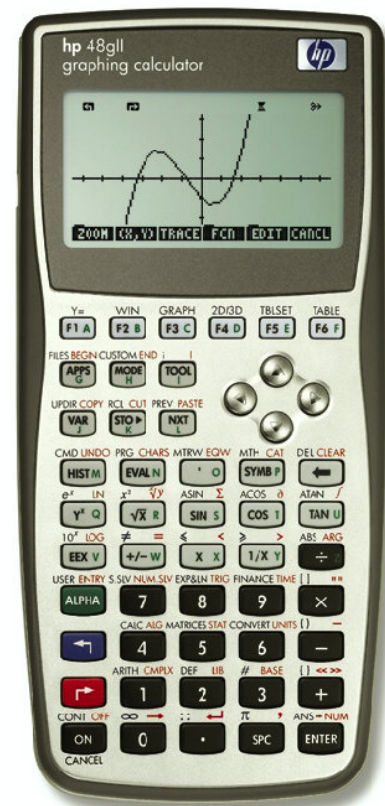


hp calculators

HP 48GII Solving for zeroes of a function

The Numeric Solver

Practice finding zeroes of a function



The Numeric Solver

The HP 48GII 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 $\boxed{7}$ key, or $\boxed{\text{F}} \boxed{\text{NUM.SLV}}$.

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 equation solver, press $\boxed{\text{ENTER}}$. The 48GII displays the following screen:



Figure 2

There is one input area on this form. This is where equation to be solved is entered. To enter an equation, press $\boxed{\text{F6}}$.



Figure 3

The cursor will be flashing between the two quote marks at the bottom left corner of the screen. The 48GII is waiting for the entry of an equation. Type in the following:



Figure 4

and press $\boxed{\text{OK}}$ shown above the $\boxed{\text{F6}}$ key at the right side of the display. The equation entered will be stored in the variable EQ in the current directory and will be displayed in the Eq: line of the screen, as shown below. If the variable EQ already contained an equation when the solver was entered, it would have been displayed in the Eq: line in the display above.



Figure 5

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If you prefer, the EquationWriter can be used to type an equation which is then placed on the stack. If you place the 'EQ' name in the first level of the stack with the equation from the EquationWriter in the second level of the stack and press $\boxed{\text{STO}}$, the equation will be stored in the EQ variable. It may be easier to do this before starting the solver for many equations.

The remainder of the screen below the Eq: line is where the 48GII solver will place variables found in the equation. Each variable will be given an input space on this screen where you can either input a known value for the variable or attempt to solve for the value of that variable if it is unknown. In the example shown, the only variable is X and there is one entry line for it as shown below.

```

SOLVE EQUATION
Eq: 'X^2-4'
X: 
Enter value or press SOLVE
EDIT  VARS  SOLVE

```

Figure 6

To solve for the value of X that makes the entered equation equal to zero, press the $\boxed{\text{SOLVE}}$ menu label above the $\boxed{\text{F6}}$ key at the right side of the display. The 48GII will solve for X and return its value as shown below.

```

SOLVE EQUATION
Eq: 'X^2-4'
X: 2
Enter value or press SOLVE
EDIT  VARS  INFO  SOLVE

```

Figure 7

Note that the solver returned only one of the real solutions to the equation, +2. The solver only finds one answer. To seek for other answers, a starting guess can be given for the variable to influence the search for an answer. It may also be easier to graph the function and look for roots in that manner. Consider what the solver returns if the cursor is placed over the X: input area and -3 is entered followed by pressing the $\boxed{\text{SOLVE}}$ menu label above the $\boxed{\text{F6}}$ key at the right side of the display:

```

SOLVE EQUATION
Eq: 'X^2-4'
X: -2
Enter value or press SOLVE
EDIT  VARS  INFO  SOLVE

```

Figure 8

The solver found the other real solution to the equation. If you do not have any idea for a possible solution, the solver will make a guess and attempt to find an answer. However, to find other answers, a user-supplied guess may be needed.

$$x^{137} + 5x^{22} - 1$$

```

EDIT  CURS  BIG  EVAL  FACTO  SIMP

```

Figure 9

Practice finding zeroes of a function

Example 1: What are some values of X for which the equation below has a value of zero? Assume RPN mode.

$$X^{137} + 5 \cdot X^{22} - 1$$

EDIT CURS BIG ▢ EVAL FACT0 SIMP

Figure 10

Solution: To find some of these X values, use the EquationWriter to enter the function and solve for a root using the numeric solver as shown.

→ EQW X Y^x / 3 7 ► + 5 X X Y^x 2 2 ► ► - / ENTER

RAD XYZ HEX R= 'X'
 CHOME3
 4:
 3:
 2:
 1: X¹³⁷ + 5 X²² - 1
 EDIT VIEW RCL STOP PURGE CLEAR

Figure 11

' ALPHA ALPHA E Q ENTER STOP → NUM.SLV ENTER ▾ 0 ENTER ▾

SOLVE EQUATION
 Eq: 'X^137+5*X^22-1'
 X: 0

Enter value or press SOLVE
 EDIT VARS SOLVE

Figure 12

SOLVE

SOLVE EQUATION
 Eq: 'X^137+5*X^22-1'
 X: .929453698745

Enter value or press SOLVE
 EDIT VARS INFO SOLVE

Figure 13

(This is one value of X for which the function's value is zero) 5 +/- ENTER ▾ SOLVE

SOLVE EQUATION
 Eq: 'X^137+5*X^22-1'
 X: -1.01264377085

Enter value or press SOLVE
 EDIT VARS INFO SOLVE

Figure 14

(This is another value of X for which the function's value is zero)

Answer: Two of the values of X for which the function has a value of zero are approximately 0.92945 and -1.01264. It might be easier to find all of the values of X that will produce a value of zero for this function by plotting this equation and seeking the roots graphically. This is covered in another training aid.

Example 2: What are some values of X for which the equation below has a value of zero? Assume RPN mode.

$$\frac{(X-4)^3 \cdot (X+3)^2}{X-1}$$

EDIT CURS BIG ■ EVAL FACTO SIMP

Figure 15

Solution: To find some of these X values, use the EquationWriter to enter the function and solve for a root using the numeric solver as shown.

→ EQW X - 4 → ^ 3 → × () X + 3 → ^ 2
→ ÷ X - 1 ENTER

RAD XYZ HEX R= 'X'
<HOME>
3:
2:
1: $\frac{(X-4)^3 \cdot (X+3)^2}{X-1}$
EDIT VIEW RCL STOP PURGE CLEAR

Figure 16

1 ALPHA ALPHA E Q ENTER STOP → NUM.SLV ENTER 0 ENTER

SOLVE EQUATION
Eq: '(X-4)^3*(X+3)^2/(...
X: -3

Enter value or press SOLVE
EDIT VARS INFO SOLVE

Figure 17

(This is one value of X for which the function's value is zero) 5 ENTER

SOLVE EQUATION
Eq: '(X-4)^3*(X+3)^2/(...
X: 4

Enter value or press SOLVE
EDIT VARS INFO SOLVE

Figure 18

(This is another value of X for which the function's value is zero)

Answer: Two of the values of X for which the function has a value of zero are -3 and 4. It might be easier to find all of the values of X that will produce a value of zero for this function by plotting this equation and seeking the roots graphically. This is covered in another training aid.