



## hp calculators

### HP 30b Programming – Automating Tasks

#### Programming on the HP 30b

#### Automating functions from menus

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Example 2: Assigning the inverse sine function

Example 3: Giving a title to a program in the program catalog







## Programming on the HP 30b









The HP 30b Business Professional calculator includes a programming capability designed to help automate repetitive calculations and extend the usefulness of the built-in function set of the calculator. The capability includes the creation of up to 10 separate programs using up to 290 bytes of memory among them.










Programs record keystrokes, with each keystroke using one byte of memory, although some commands use more than one byte. In addition, many program-only functions are provided for conditional tests, "gotos", looping, displaying intermediate results and even calling other programs as subroutines.

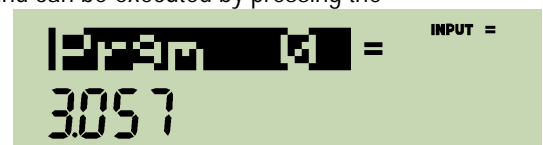
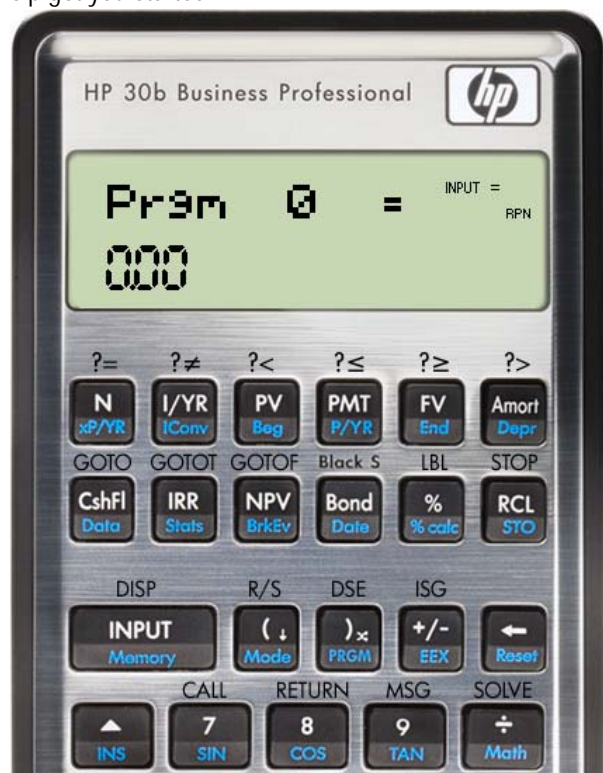
This learning module will show how to automate repetitive calculations to save time as well as how to bring functions out of menus and onto the keyboard. Other learning modules will show how to enter and edit programs, loop and call subroutines as well as showing several example programs to help get you started.

As shown in the picture at right, the HP 30b has additional functions assigned to the keys that are program-only functions. Other than the Black-Scholes function (shown as Black S), which is not a program function but a financial function, these functions are not printed or labeled on the actual HP 30b itself. However, an overlay is provided that lays over the top rows of keys that help indicate how these functions are mapped to the keys.

Each of these functions is inserted into a program by pressing the shift key and holding it down while pressing the key under which the program function is displayed. For example, to insert a LBL (label) command, press  and, while holding it down, press . In these learning modules describing programming, this will be shown as  + . Pressing that key combination will insert a LBL instruction into a program in program edit mode. Pressing that key combination in calculation mode will do nothing.

There are 10 numbered slots available for programs, numbered from 0 to 9. These are displayed in the program catalog which is viewed by pressing  . In the image above, the program catalog is displayed, showing Prgm 0 or program 0. Pressing the  or  keys will scroll through the list of 10 programs. Pressing  will enter the selected program, allowing you to view the program steps stored in that program slot or to change the program steps. To exit this program editing mode and return to the program catalog, press  . To exit the program catalog and return to calculation mode, press .

When a program is displayed, a number will be shown below it indicating how many bytes are used. If the program name is shown in reverse video, then the program has been assigned to a key and can be executed by pressing the appropriate key combination, even when in calculation mode, as shown in the image at right. When viewing a program in the program catalog, pressing    will delete the presently displayed program and return to the calculation environment. To delete all programs, press       while in calculation mode.

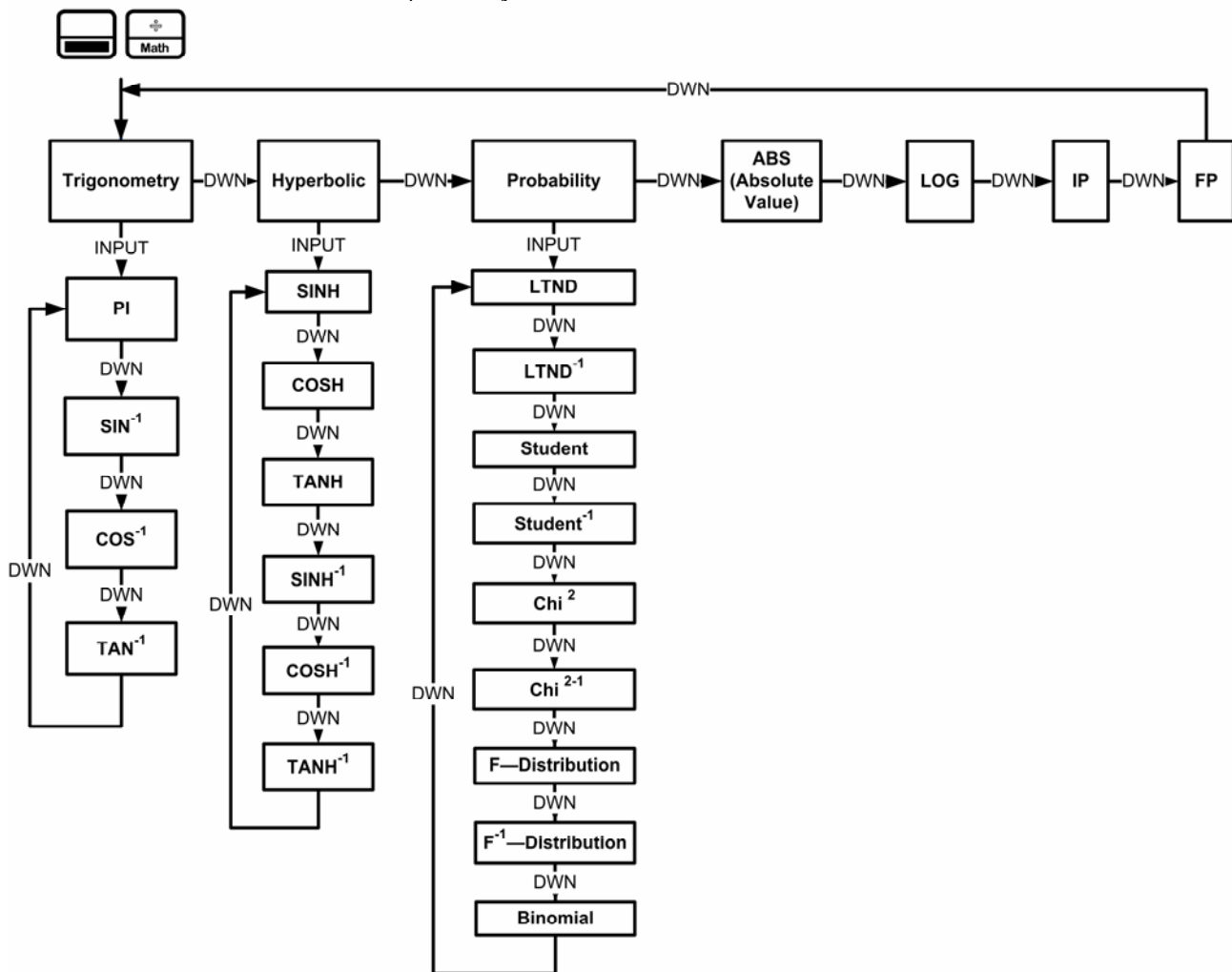


At different places within a program, you can insert a Label (LBL) command. A label defines a location to which program control may be transferred. The HP 30b can handle up to 100 labels within the entire program memory. These labels are a two-digit numeric value from 00 to 99. No label can be used more than once, which makes each label a "global" label and defined only once within the global program memory space. If you attempt to enter a label that has already been used, a message saying "Exists!" will be briefly displayed.

### Automating functions from menus

The HP 30b is a powerful calculator containing many useful functions. Some of these functions are found several layers deep in menus. If you need to use a function deep in a menu several times in a row, this can become somewhat tedious. With a small investment in time, it is possible to easily bring a function out of a menu where it can be accessed at the press of a key. This is done by writing a short program that executes the function where the key presses necessary to access the function are entered by the program itself.

**Example 1:** Suppose you needed to compute the area under the normal distribution curve for a number of standardized z-score values. The normal distribution probability function is labeled LTND located in the math menu as shown below.



To automate this type of function found in a menu, make a list of the exact keys pressed to access the function manually. These key presses will be entered in the program. In this case, once the standardized z-score is in the display, you

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would press . The final (a final works just as well) is necessary to have the HP 30b execute the function instead of just previewing the potential answer.

Note: To enter a (or or or ) function in a program, it is necessary to press , hold it down and press the appropriate key (such as ) before releasing the key. This will be shown in the program listings as + .

To enter this series of key presses into a program, you would press the following keys.



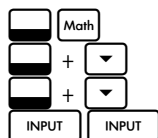
Enters program mode and displays the last program previously viewed in the program catalog. If you wish to enter your program into a different program number in the catalog, press or until the program number you wish to use is displayed. Then press:

Prgrm 0 = =



Enters program edit mode and displays the first line of the program, which will be blank as shown at right if this is a new program. Then press the keys needed to access the function in the menu. With each key press, the HP 30b will briefly display the function recorded and move to the next step location to record the next key press.

--- = 1



These key presses will access the normal distribution probability function in the math menu. The next step would be step 6 of the program.



--- = 6

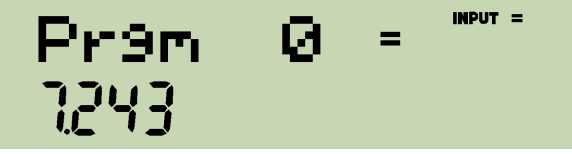







This keypress enters a STOP command. This command ends program execution and returns control to the user. The program advances to show an empty program step number 7, but this will not be used. Press to scroll through the steps of the program, which should look like those shown below.

--- = 7

Math = 1	Down = 2
Down = 3	Input = 4
Input = 5	Stop = 6





To exit program edit mode, press  . This returns the HP 30b to the program catalog and now displays Prgm 0, showing the program's 3 digit checksum of 243 and that the program uses 7 bytes of program memory.












One way to run this program is from the program catalog. With Prgm 0 shown in the display, you can enter a z-score for which you want to have the cumulative probability computed and press  . This will run the program and return the result. For example, press   . The program runs and displays the result below. Note that running the program in this way exits the program catalog.





To run the program again, you can re-enter the program catalog, key in another z-score and rerun the program. However, this is also rather keystroke intensive.

Fortunately, you have the ability to assign a program to a key. Once assigned to a key, pressing the key will automatically run the program. Suppose you wanted to assign this program to the   key position. To make this assignment, re-enter the program catalog by pressing  .

Note: If you assign this program to the   key position, the random number function is ONLY available if you clear the program key assignment or if you press  +  (shift-hold ) while in the calculation environment (since the random number function is the shifted function of the 1 key). If the shift-hold  position ( + ) has ALSO been assigned to a program, the original functionality of the key position will be unavailable until one of the key assignments has been cleared. To clear an assignment, press  when program step 0 is displayed.

The program catalog is displayed showing program 0. Press  to begin editing the program. Now press . This takes the program listing to step 0, as shown below.



The HP 30b will automatically assign a program to the key represented by the step entered at step 0. With step 0 shown, press   to assign this program to that key position on the keyboard. Note that the program step location did not advance when the program assignment was entered – it stayed on step 0, as shown below.

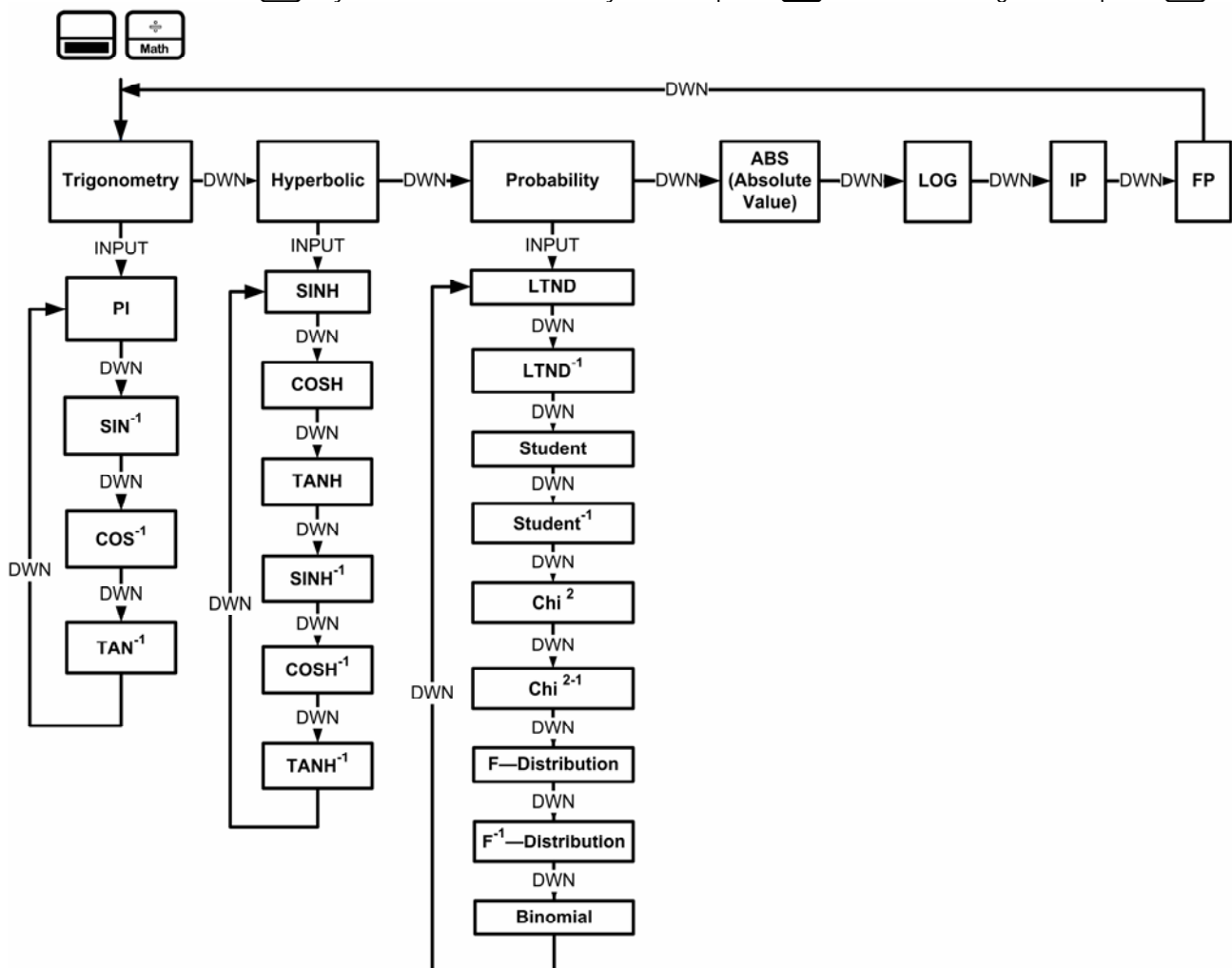


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Now press  $\square$   $\square$  ON/CE to exit the program editing environment. To run the program, key in a z-score and press  $\square$   $\square$  RAND. For example, to compute the area under the normal distribution curve for the z-scores of 1, 0 and 0.5, you can now press:

$\square$   $\square$  RAND then  $\square$   $\square$  RAND and then  $\square$   $\square$  5  $\square$   $\square$  RAND. You have now extended the HP 30b keyboard by placing the normal distribution probability function on the keyboard at the location  $\square$   $\square$  RAND. This saves a large number of key presses and is actually very easy to do.

**Example 2:** The HP 30b has the three basic trigonometry functions, sine, cosine and tangent on the keyboard. The inverse trigonometry functions are in the Math menu, however, as shown below. If you need to use the inverse trigonometry functions often, you can assign these functions to the "shift hold" positions of the three trigonometry functions that are on the keyboard. You can visualize this by looking at the HP 30b keyboard. Every key except the shift key itself has two functions: the function printed on the top of the key and the blue function written on the front slope of the key. Each of these two locations can be "assigned" as the starting key for a program. In addition, you can define assignments of programs to the shift and hold key position as well. In this example, we will assign the inverse sine function to the shift-hold  $\square$  7 key. To access that function, you would press  $\square$  and while holding it down, press  $\square$  7.



To automate this type of function found in a menu, make a list of the exact keys pressed to access the function manually. These key presses will be entered in the program. To perform an inverse sine, you would press

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. The final (a final works just as well) is necessary to have the HP 30b execute the function instead of just previewing the potential answer.

To enter this series of key presses into a program, you would press the following keys.



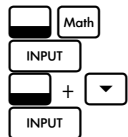
Enters program mode and displays the last program previously viewed in the program catalog. Since Prgm 0 was used before, press until program number 2 is displayed. Then press:

Prgm 1 = =  
000



Enters program edit mode and displays the first line of the program, which will be blank as shown at right since this is a new program. Then press the keys needed to access the function in the menu.

--- = 1



These key presses will access the inverse sine function in the Math menu. The next step would be step 5.

--- = 5



This key press enters a STOP command. This command ends program execution and returns control to the user. Press to scroll through the steps of the program, which should look like those shown below.

--- = 6

Math = 1	Input = 2
Down = 3	Input = 4
Stop = 5	

To exit program edit mode, press . This returns the HP 30b to the program catalog and now displays Prgm 1. The number of bytes used by Prgm 1 is shown below it in the display. The automation program uses 6 bytes of memory and has a checksum of 047.

To assign this program to the + key position, enter the program catalog by pressing . Press to view step 0 of this program where the key assignment will be entered. To assign this program to the + key position, press + . The display should appear as shown below. SH7 stands for "shift-hold 7" which is the shift-hold sine function position.





Press to exit the program edit mode and return to calculation mode. Assuming the calculator is in the degrees angle mode, calculate the sine of a 25 degree angle by pressing . The display should appear as shown below.



To find the angle again by executing the inverse sine function, press + . The display should appear as shown below.



Note that in this example, an assignment was made to a key position that already had a shift-hold function assigned to it by the HP 30b itself: the CALL programming environment function. In the calculation environment, the inverse sine program assignment will be executed. If you press this shift-hold key position while editing a program, the CALL function will be entered into the program, since that assignment is active in program mode.

**Example 3:** Change the previous program so that step 1 contains the MSG "INV SIN" so that the program will show those characters as a title in the program catalog listing. Remember that to move the character position to a numeric digit as a letter in a message, press the corresponding numeric key. To move to an =, press . Pressing moves to the ? character. Pressing moves the character position to a space. The arithmetic operators move the character position to the corresponding operator character. Press to select the displayed character and prepare to enter another character. Press to select the displayed character and terminate character entry. A maximum of 8 characters may be entered as a message.

To modify the program, do the following.



Enters program mode and displays the last program previously viewed in the program catalog. Since Prgm 1 was used before, it is displayed again. It is shown in "reverse video" to indicate that it is assigned to a key. Then press:



Enters program edit mode and the first line of Prgm 1, the command to enter the Math menu. Then press:



Inserts the MSG command at the presently displayed position. Begins by showing an "A" in the display. Press the following keys to enter the message "INV SIN":



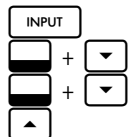


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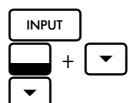
Moves character position to display an "I"

I =



Enters the "I" character and presents a lowercase "a" after pressing the **INPUT** key.  
Moves character position to show "N"

IN =



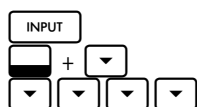
Enters the "N" character.  
Moves character position to show "V"

INV =



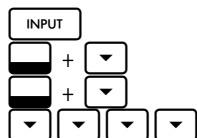
Enters the "V" character.  
Moves character position to a space, which is present but not visible in the image at right.

INV =



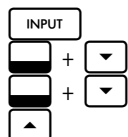
Enters the space character into the string.  
Moves character position to "S"

INV S =



Enters the "S" character into the string.  
Moves character position to "I"

INV SI =



Enters the "I" character into the string.  
Moves character position to "N"

INV SIN =

Press **ONCE** to terminate entering the message. The display will shift to show line 2 of the program. Now view the program once again in the program catalog by pressing **PRGM**.

INV SIN =  
15.145

Although this takes some key presses to input, some users will find this ability to give a title to a program very useful, as the function of the program will be much more evident from "INV SIN" being displayed in the program catalog than the generic "Prgm 2". The title is displayed in "reverse video" because this program is assigned to a key from example 2. Note that inserting the MSG to give this program a title used an additional 9 bytes of memory (15 – 6 from the previous example). Remember that if you make a mistake while entering a MSG, you can press **←** at any time before you press **ONCE** and the character at the end of the message will be deleted. Note that the MSG command is perhaps most useful to enter a string of characters in a program to display a prompt to the user before the program stops for input. This prompting message can help the user know what values to enter before resuming program execution. The use of the MSG command here to give a title to a program in the program catalog is simply another use of this function.