

TI 83/84 calculators: An introduction for GCC students



Presented by GCC Tutoring Services
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Using TI-83/84 Calculators

(Applies to all TI-83 and TI-84 series calculators, including the Plus and Silver Editions. Other TI calculator models, for instance the -85 / -86 / -89 / -92 etc, may work differently.)

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Topics covered:

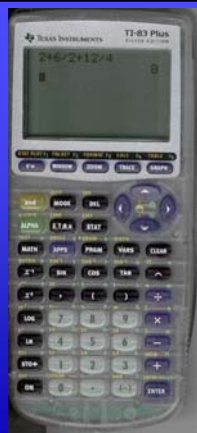
- Basic math operations
- Graphing
- Powers, Scientific Notation, and Roots
- Log and Natural Log (and related topics)
- 1-Variable Statistics
- Complex Number operations
- Variables
- Applications and Programming
- Online resources for TI calculators

Basic functions

Some TI-83 differences from “normal” calculators:

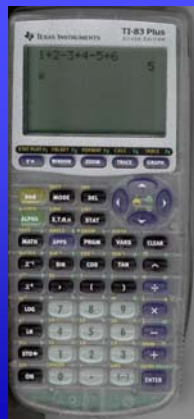
- Algebraic order of operations
 - “PEMDAS” from math class: **P**arentheses / **E**xponents / **M**ultiplication – **D**ivision / **A**ddition-**S**ubtraction
 - Evaluates entire expression when ENTER is pressed, rather than one operation at a time.
- Ability to edit expressions (somewhat like a word processor for numbers)
- Graphing and other advanced capabilities
- <ENTER> instead of “=” to solve expression

- For example, a standard calculator would compute “ $2+6/2+12/4$ ” as
- “2, plus 6, divided by 2, plus 12, divided by 4,” and would get 4 as the result...
- $2+6 = 8$; $12 / 2 = 6$;
- $4 + 12 = 16$; $16 / 4 = 4$
- A TI 83/84 calculator would instead perform the division first, and give the “correct algebraic” answer of 8...
- 2, plus (6/2), plus (12/4),
- = $2+3+3 = 8$.



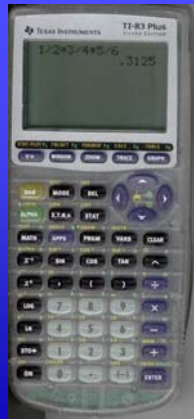
To add and subtract numbers:

- Key in the numbers and the + and – keys, just as you would on a standard calculator.
- The example at right shows $1+2-3+4-5+6$
- Addition and subtraction will be performed in the order entered (unless parentheses are used)



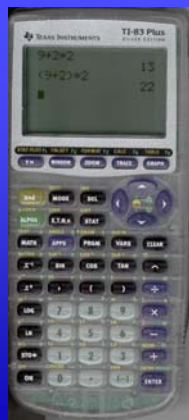
To multiply and divide numbers:

- Key in the numbers and the \times and \div keys, just as you would on a standard calculator.
- The example at right shows $1 \div 2 \times 3 \div 4 \times 5 \div 6$
- Multiplication and division will be performed in the order entered (unless parentheses are used)

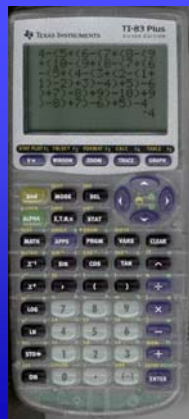


Using parentheses:

- To perform operations in a specified order, parts of expressions can be grouped by using the parentheses keys.
- For instance, $9+2*2$ would normally be computed as “9, plus the quantity $2*2$,” or 13.
- If you wanted to add the 9 and the 2 first instead, you could enter the expression as $(9+2)*2$, which would be $11*2 = 22$.

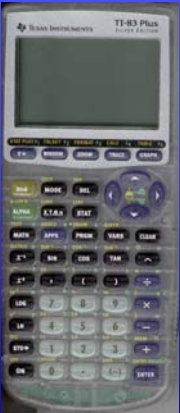


- Parentheses can also be “nested” (that is, you can have pairs of parentheses inside other pairs.)
- The TI-83/84 series can work with a lot of nested parentheses – at least 30 pairs – correctly(!)



TI-83 key layout

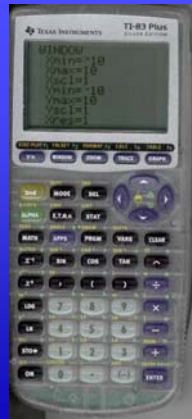
- Most of the keys on the TI-83 serve more than one purpose.
- Functions in **gold** are accessed by pressing the “2nd” key, then the key underneath the function name.
- Similarly, functions in **green** (mostly letters) are accessed by pressing the green “ALPHA” key, then the key underneath the letter or function.



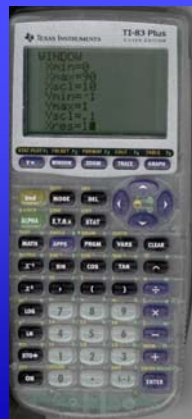
Graphing

- Put the function to be graphed into the form $y=f(x)$. That is, solve the function for Y in terms of X .
- Decide on a “window” over which to graph the function. This will be the range of values of X and Y that you want to show on the screen.
 - The display on the TI-83/84 series is 94x64 pixels (dots). That is, the display has roughly a 3:2 ratio – and if you choose a window about 1.5 times as wide as it is tall, the graphs will have roughly equal scaling in the X and Y directions.
 - For example, to graph a circle of radius 10, you might set the window to $(-15,-10)$ — $(15,10)$. This should show the circle properly, without “squashing” it in either direction.
 - You can enter coordinates with different aspect ratios, if necessary to show the function properly.
- Remember your window coordinates, so you can enter them (in the next step).

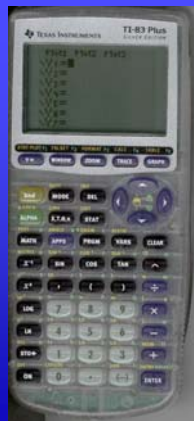
- Turn the calculator on (the “ON” key is located in the lower left corner.)
- Press the “WINDOW” key to access the graph window settings screen.



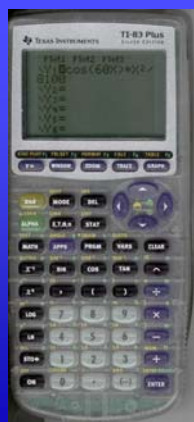
- The screen will appear like the example on the right (perhaps with different values entered for each parameter).
- Enter in the minimum and maximum values for the X and Y directions. (Press **ENTER** to move from one number to the next.)
- If you make a mistake, you can use the arrow keys to move back and correct it.
- Set the X_{res} to 1 for best quality; 2 for more speed.



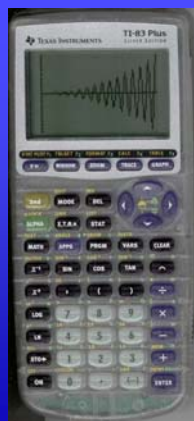
- Once you have the window set, press the **Y=** key to access the graphing function screen. The display will now look like the example on the right (some functions may already be entered).
- Use the arrow keys to select a function (or just start editing the first one)



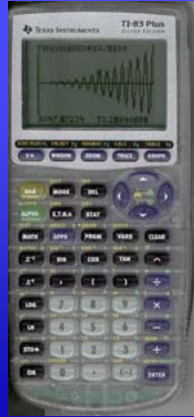
- Enter in your function (the **y=** is already there). The TI-83 uses algebraic order of operations; something like $3+2*4$ will be evaluated as 11, not 9.
- Press **ENTER** to save the function.
- If there are other functions displayed which you don't want to graph, use the arrow keys to move to them, and press **CLEAR** to erase them.



- Press the **GRAPH** key to display the graph of your function.
- More difficult functions may take a bit longer for the calculator to graph.



- Once your function is displayed, you can trace along it (for example, to find coordinate pairs which satisfy the function) by pressing the **TRACE** key.
- After **TRACE** is pressed, use the arrow keys to move the cursor left or right along the function.



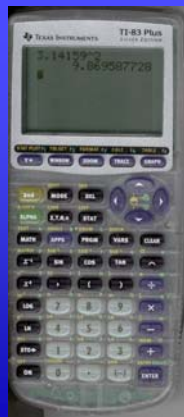
Powers, Scientific Notation, and Roots

To raise a number to a power:

- Turn the calculator on
- Type in the number to raise to the power
- Press the ^ key
- Type in the power
- Press ENTER

For example, to enter $(3.14159)^2$ as shown at right, you would type:

3.14159 ^ 2 <ENTER>



To use scientific notation:

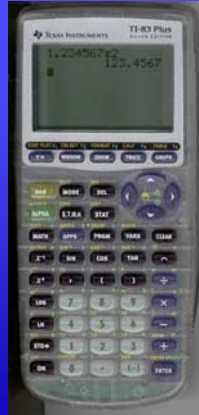
TI calculators have a shortcut for entering scientific notation.

To use it:

- Turn the calculator on
- Type in the base (the decimal part of the number)
- Press the 2ND key
- Press the EE key (note the "EE" in gold directly above this key)
- Type in the power of ten (for negative powers, use the (-) key)
- Press ENTER

For example, to enter 1.234567×10^2 as shown at right, you would type:

1.234567 <2ND> < , > 2 <ENTER>



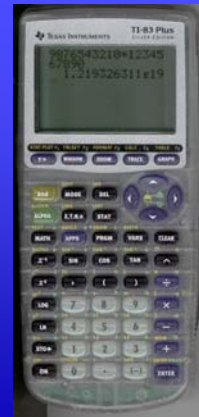
TI series calculators will resort to scientific notation for large numbers. To see an example of this, type in the following:

9876543210 * 1234567890
<ENTER>

You should see displayed:

1.219326311E19

This means that the answer is (roughly) 1.219×10^{19} , or about 12 quintillion(!)



Roots:

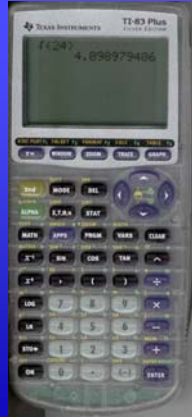
- A "Nth root" of a number is the number that, when multiplied by itself N times, equals the number.
- 2nd roots are called "square roots" (since they give the length of the side of a square of a given area)
- 3rd roots are called "cube roots" (since they give the length of the edge of a cube of a given volume.)
- A root, like a power, can be any number at all – even negative, fractional, irrational, and/or complex (except that a root, unlike a power, cannot be zero.)
- The TI-83/84 series can calculate any valid root of any number.

To take the square root of a number:

- Turn the calculator on
- Press the 2ND key
- Press the X² key (note the square root symbol in gold above it). This will also automatically open a set of parentheses.
- Type the number for which you want the square root
- Press the) key to close the parentheses. (This is not technically necessary on the -83 and -84, but is a good habit to get into, so you don't get unwanted results on more complicated calculations.)

For example, to enter the square root of 24 as shown at right, type:

2ND X² 24) <ENTER>

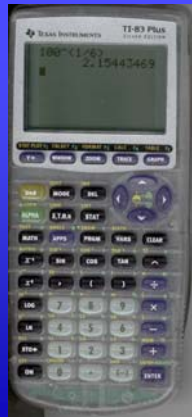


To take the Nth root of a number:

- The Nth root is taken by raising the number to the (1/N) power. For instance, taking the 4th root of a number of a number is the same as raising that number to the 1/4 power.
- Type in the number to be raised to the power.
- Press the ^ key
- Press the (key to open a set of parentheses
- Type in the fraction of the root you want to take. For the 17th root, type 1/17 etc)
- Close the parentheses with the) key.

For example, to enter the sixth root of 100 as shown at right, type:

100 ^ (1 / 6) <ENTER>



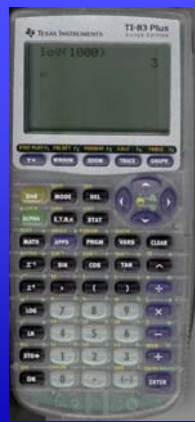
Log and Natural Log

- Logarithms are used in many different applications. Basically, a logarithm is the power to which you would have to raise the “base” in order to get the desired number.
- An explanation of what logarithms do is beyond the scope of this presentation; we will simply work with how to calculate them using the TI 83/84.
- For more information on logarithms and their uses, check out the following links:
 - <http://www.wikipedia.org/wiki/Logarithm>
 - <http://mathworld.wolfram.com/Logarithm.html>
 - <http://mathworld.wolfram.com/NaturalLogarithm.html>

To take the log (base 10) of a number:

- Turn the calculator on
- Press the **LOG** key
- Type in the number
- Close the parentheses with the **)** key
- Press **ENTER**

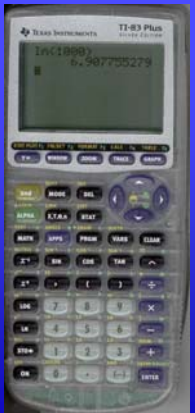
The example at the right shows $\log(1000) \dots$
LOG 1000) <ENTER>



To take the natural log (log base e) of a number:

- Turn the calculator on
- Press the **LN** key
- Type in the number
- Close the parentheses with the **)** key
- Press **ENTER**

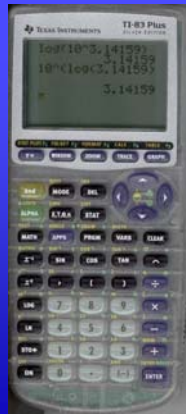
The example at the right shows $\ln(1000) \dots$
LN 1000) <ENTER>



- $\log(x)$ and 10^x are complimentary operations, as shown in the example at right:

$$\log(10^{3.14159})=3.14159$$

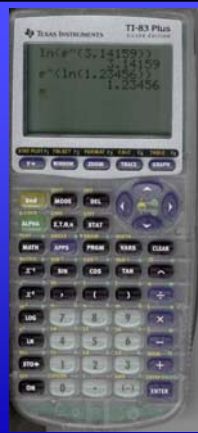
$$10^{(\log(1.23456))}=1.23456$$



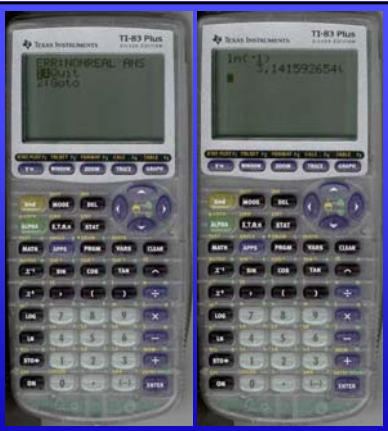
- $\ln(x)$ and e^x are complimentary operations, as shown in the example at right:

$$\ln(e^{3.14159})=3.14159$$

$$e^{(\ln(1.23456))}=1.23456$$

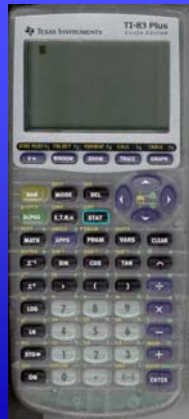


- Depending on what "mode" the calculator is in, if you ask for the log or ln of a negative number, you'll either get an error message or a complex number.
- (Complex number math on the TI-83/84 is covered in another presentation)

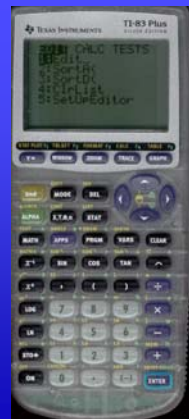


1-Variable Statistics

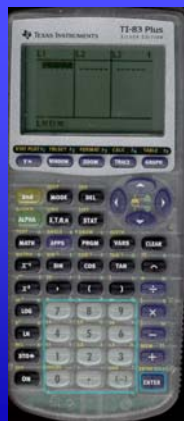
- Turn the calculator on (the “ON” key is located in the lower left corner.)
- Press the “STAT” key to access the Statistics menu



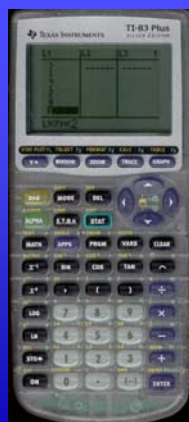
- The **STAT** key calls up the Statistics menu group; the EDIT submenu and the Edit... command are selected by default.
- Press the **ENTER** key (at lower right) to access the Editor.



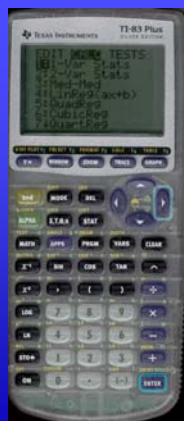
- The screen at right shows the Statistics Editor. There are six lists, numbered L1 through L6.
- For the 1-Variable Stats, only one list is needed. (We'll use L1 for this example.)
- The cursor starts on the first element of L1. Key in the value, and press **Enter**.
- Repeat for all values in the list.



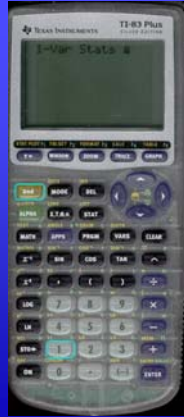
- Once all the values are entered, you can review them by scrolling through the list using the arrow keys. If one or more values are incorrect, they can be re-entered.
- When you have checked the entries, press the **STAT** key to access the Statistics menu again.



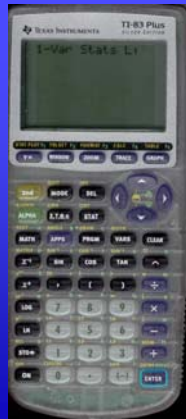
- When the Statistics menu is on the screen, press the **right arrow** once to access the Calc submenu.
- The “1-Var-Stats” command is the default choice on this submenu; press **Enter** to select it.



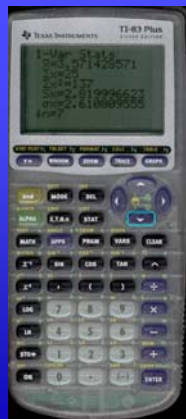
- This will show the command “1-Var Stats” on the screen.
- If entered like this, with no parameters, the L1 list will be used by default.
- The L1 list (or another list) can be specified explicitly by pressing the “2nd” key, then pressing the key (1 through 6) corresponding to the desired list.



- The command can also be entered specifying the L1 parameter, as shown.
- If a list other than L1 is to be used, this parameter (L2 through L6) is required.
- Once the command is correct, press the **Enter** key to do the calculation.




- This is the “1-Var Stats” display. The entries are, in order:
 - The mean value;
 - The sum of the values;
 - The sum of the squares;
 - The sample standard deviation;
 - The population standard deviation; and
 - The number of items in the list.
- More data is available; press the **down arrow** to see it.



Complex Number Math

To set the TI-83 up to work with complex numbers:

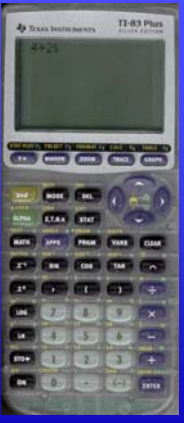
- Press the MODE key
- Press the down arrow six times, to access the “Real / a+bi / re^0i” option.
- We recommend the “a+bi” option (Cartesian notation) for working with complex numbers (unless your professor states otherwise); use the arrow keys to move the cursor to this option and press ENTER.

A TI-83 Plus calculator is shown in the MODE menu. The screen displays 'MODE' at the top, followed by 'NORMAL SCI ENG', 'F1 F2 F3 F4 F5 F6', 'REAL a+bi re^0i', 'POLAR', 'RECT', and 'DEGREE RADI DEGREE'. The 'a+bi' option is highlighted with a cursor.

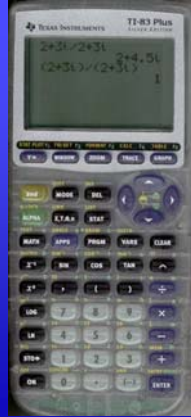
- Complex numbers are entered by adding a real part and an imaginary part. For instance, if you wanted to enter the complex number $4+2i$, you would key in:

$4 + 2 <2ND>$

(The last key is the decimal point, since the gold i is located above it)

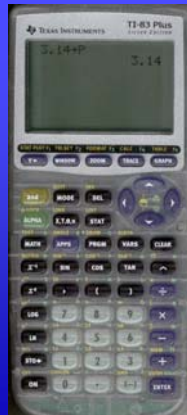
A TI-83 Plus calculator is shown with the number '4+2i' displayed on the screen. The calculator is in the MODE menu, and the 'a+bi' mode is selected.

- To work with complex numbers, simply key them into the calculator.
- For clarity, you can use parentheses around each complex number, to ensure it is treated as one unit (for example, for division problems).
- The answer should appear in the format you selected in the MODE screen.

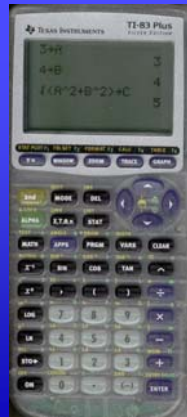


Variables

- The TI-83/84 series has the capability to store numeric results in letter variables. To do this, you use the <STO> key, located just above the ON key.
- For example, to enter 3.14 into the variable "P," you would key in:
3.14 <STO> <ALPHA> 8 <ENTER>
- (Note: you don't need to use P to stand in for Pi, since the TI-83 already has a Pi constant; this was just an example.)

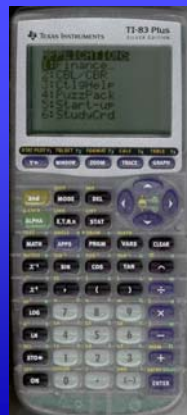


- Once you have numeric values stored into variables, you can perform operations on them and use them in expressions...

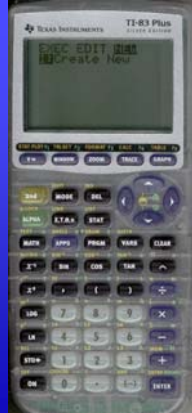


Programming and Applications

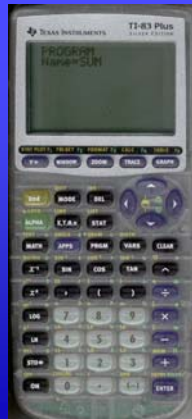
- The TI-83/84 series has the ability to be programmed, and/or to run downloaded applications from the Internet.
- <http://education.ti.com> is a good source for apps and information.
- Applications can be accessed by pressing the <APPS> key; some TIs come preloaded with apps.



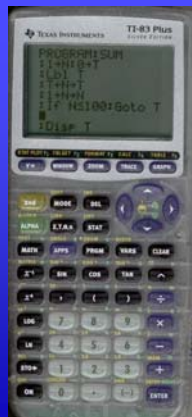
- The TI-83/84s can also run user-created programs.
- In-depth coverage of TI programming is beyond the scope of this workshop; the programming language is covered in detail in the guidebooks provided by TI.
- To start a new program, press the <PRGM> key, then move to the “NEW” menu choice and press <ENTER>.



- Give the program a name and press ENTER; this will call up a blank programming screen.
- The TI-83/84 can be programmed in its own algebraic language; details are available in the instruction manual and/or through <http://education.ti.com>.



- Here is part of a sample program which computes the sum of the numbers between 1 and 1000.
- The IF statement in the 5th line controls the program flow; the program runs through N=1 to N=100, summing the results into T, then breaks out of the loop and displays the result. (This is inefficient, but a good example of an IF statement.)



Online Resources:

- <http://education.ti.com>
(TI's main Calculator website; Guidebooks, applications, OS updates, general info etc.)
- <http://www.prenhall.com/divisions/esm/app/graphing/ti83/>
(Tutorial)
- <http://www.ticalc.org>
Lots of interesting applications, forums, etc
- <http://en.wikipedia.org/wiki/TI-83>
General information on the TI-83/84 series, plus links

For further assistance:

- Walk-in Math tutoring (for all levels) is available in FAC 208 Mon-Thu from 1:00PM to 2:00 PM during the Fall and Spring terms; no appointment is necessary.
or
- Stop by or call the FAC or LGC Tutoring Center to make an appointment for one-on-one assistance.
 - **FAC (Room 208): 540.891.3017**
 - **LGC (Room 208): 540.423.9148**
