Real Comparison Between the TI-89 and the HP-49G

The first question that needs to be answered here is why did this guy spend time making another one of these stupid things. The answer is that while there are other comparisons available out there, none that I have found give a real representation of the differences between the two calculators. Most set out to prove that one calculator is better than the other, when in reality each calculator has its own strengths and weaknesses. I set out to provide an informative document that illustrates these differences so that information is available to choose which is better for your individual needs, or just for information's sake.

Now I will be happy to discuss any points of disagreement with anyone, provided that you don't act like a first grader (or less) when doing so. E-mails that consist of "TI RULES! – HP SUCKS!" or vice versa will be ignored. To those people I say, GROW UP. If you would like to provide a mature argument or a different idea, I would love to have you write to me. Feel free to write me at timwessman@yahoo.com

The format to be used for the rest of this document will be as follows. I will be comparing built in features of the calculators first. Why only built in features first? That's because the average user doesn't own a computer to calculator cord. Face it, most of us reading this will be die-hard calculator nerds (in a positive way! :-), that own a cord and spend time doing nerdy things like programming. Features of each calculator will be compared and contrasted, but I will not be drawing conclusions from this but rather allowing the reader to draw their own. I will be pointing out things that are inefficient or that have a better solution but I will not be doing a blow by blow tally system to come out with a "winner".

After built in features, I will be comparing external things like support, manuals and user written programs. In an effort to provide the best possible picture, I will be using many screenshots and examples. I have checked and double-checked my info, but it is impossible that I will get everything correct on the first try. If you notice a mistake, feel free to respond to me at the above e-mail address. Everything in this document is based on personal experience, reliable sources or the experiences of other calculator nerds (my friends) around me. I intend to cover as much as I can from the basics up to things for the advanced user, so this document will most likely get out of hand. I am more familiar with the 49 as it is my principal calculator, and will explain much more in depth about it then the 89. I always like learning more stuff about all calculators and since most of you are familiar with the 89, I'll try to explain everything as well as I possibly can. Anyway, without further ado, here we go.

First Look

Below is a small picture of each calculator. As you can see, the 89 followed the traditional coloration scheme of their earlier graphing calculators by using a black case, and green and yellow shift buttons. New is the addition of purple for alpha. In contrast, HP decided to abandon all tradition and go for a shiny metallic blue with dark metallic blue left shift, metallic red right shift, and green for alpha. Which is preferred is a matter of preference. Many students have told me that my calculator was "awesome" while others thought it was too colorful. Many of the earlier HP users dislike the new coloration. The 89 has a black case while the 49 has a translucent blue, keeping with the metallic theme. Both cases have a tendency to loosen up after a long period of use, and can be stiff at first. Additional colored covers are available for purchase from TI for approximately $15.

Size and Feel: Both calculators are almost the same size. When looked at from a distance, the 49 appears to be larger. In reality they are almost identical size. The 89 weighs less than the 49, while the HP has a more solid feel to it. This comes from the stiffer plastic used for the shell. There are also 4 rubber feet on the 49 on both the bottom of the calculator and on the sliding case. The 89 has two rubber feet on the bottom of the calculator. The 49 is less prone to slipping off of a desk or book with these extra feet.

Power: Opening the battery case on the back reveals a difference. The 89 has four AAA batteries and a small watch battery to retain memory when changing batteries. The 49 uses only three triple A's and no backup battery. The 49 uses an internal capacitor to retain memory while changing batteries, but if the batteries are not replaced within a few minutes the RAM can be wiped. (more on memory later)

Keyboard Comparison: The 49 appears to have fewer keys than the 89 because they are smaller, but actually has one extra key in the top row of "F" keys. The 89 has fewer functions directly available on the keyboard, with only 23 having both a 2nd and 3rd function on them (at least printed on the board). The 49 has almost every key assigned to both a 2nd and 3rd function. Both keyboards appear to be "cluttered" to the same extent. The HP appears to be less cluttered then it actually is because of the smaller keys, and the placement of letter keys on the keys themselves in a green circle. The metallic blue shifted functions can be hard to read in some direct light, but is not a large problem.
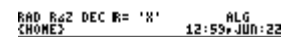
Some of the best programmers and users of the 48 series designed the 49, and it is obvious that the people who designed it use calculators themselves. One of the most disturbing things about the layout on the 89 is having X, Y, Z and T as a primary function. I personally use sin, cos and tan much more than Y, Z or T. In addition, having three keys out of place with the other alpha keys is more difficult to get used to for new users. X is essential as a primary function so that key placement is good for both calcs. On the 49 the X key is also in the position it should be with relation with the other alpha keys. A feature of the 49 that is very handy is the insertion of both parenthesis or list delimiters at once. On the 89 you have to manually enter the ending delimiters.

I will break the mold here and say one thing about typing alpha characters. The 49 whips the 89 in this respect with no questions asked. The layout on the 49 allows arrows, all numbers and all but one math symbol (/) to be typed while in alpha mode. It's very annoying while typing to have to leave alpha mode to type a number. It's obvious the designers knew this.

The keys on the 49 are slightly harder to press. Old 49's had very hard keys that took a long time to soften up, but all manufactured now have been fixed although they are still slightly harder then the 89's key-presses. The 49 has rubber keys, not plastic. Some like the feel; others despise it. I don't really mind.

Screen: The screens on both calculators look the same size while off, but as soon as they are turned on, it's apparent that the 89 has a much larger screen (almost twice as big). For regular math functions however, the screens are about the same. This is due to the 89's F-menu keys on the top and the entry line/settings

area below. On the 89 you're stuck with this view. On the 49 though it is all customizable (more on that later). The programmers have managed to get over this screen limitation (limited by the hardware) by clever use of different font sizes and good programming. The header can be removed if desired or shrunk to one line, depending on preference.

The major problem with a smaller screen is for games. The 89 can have much more detailed games with a larger area on screen at once without the need to scroll. Graphing is also more detailed on the 89 then the HP.

Built In Features

Both these calculators have impressive built in features. I'm sure that if any one of us were sent back to the 60's or 70's with our calcs, we would be captured and interrogated a threat to national security. Both of these calculators are more powerful then anything that would exist for another 20 years or so. I've heard somewhere that in terms of computing power, these calculators are about equivalent to a slow 386 (long live Dune II, greatest RTS ever, imho ;-). The 89's greatest strength is its consistency in the OS. Everything behaves exactly how everything else does, and it's easy to use. The 49's greatest strength is the ability to customize how it behaves. The ability to use either choose boxes or soft menu buttons is a strength in the 49 because soft menu buttons tend to be quicker then choose boxes once learned.

Customizing: Don't get me wrong, the 89 and the 49 are both very capable calculators. Both of them have some features that the other doesn't. There are some very silly features on the 89 that are lacking in the 49. (has anyone ever seriously used the rolling ball graph for anything besides amusement during a dull math class ;-) Both calculators will serve you well, and depending on what you want out of your calculator, one will be better then the other FOR YOU INDIVIDUALLY. The greatest feature of the 49 is its personality.

You heard me, personality. My calculator is my calculator, different then anyone else's. That is because I can customize almost anything with the built in options, and with a little programming knowledge I can customize anything I want on the calculator. Here are a few examples. Do I want algebraic or RPN. I like RPN. It's faster and the more natural way to do math. It's more efficient because that's the way computers do math. Take two things; apply some function to them. (most people actually use RPN anyway on their calculators without knowing it. Most people I know will do part of a large equation, then use the ANS key to recall their answer to finish the problem. RPN isn't really hard to use, we've all just been taught since we were younger to think in 'algebraic+alegebraic' entry. After 30 min of RPN, most never go back.)

It's easy to customize the calc with the built in menus. You can change the CAS settings and the display setting. I've heard a complaint that HP's own comparison says that the TI-89 has only one font. While this isn't exactly true because there is a mini-font on the 89, HP meant that the font size couldn't be changed to different sizes and styles. You can even make your own fonts on the 49 if so desired. One of my teachers can't use the 89 because he can't read the screen unless wearing his reading glasses. Moral of the story: If you don't like it, change it! If you don't like how the 89 display is set up, too bad. . . sorry.

There is a problem with this extreme customizability though, many new users have a hard time because the will change something and not remember what they did, or how they did it. So the calc will do something because of a flag setting, and they will think it's broken because it isn't giving the expected answer.

Both calculators can have custom key assignments, but the 89 is limited to programs attached to number keys. The 49 can have any program assigned to any key on any shift plane. That means if you don't like the keyboard arrangement, or want quick access to programs, you can put assign them to anywhere.
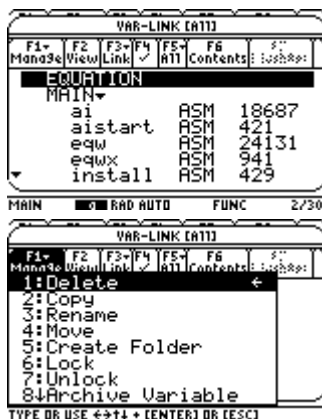
Memory: Both these calculators have lots of memory. For the 89, 188K of ram and 384K-archive memory provide ample space. AMS 2.xx expands the archive memory to 700K providing a great deal more storage. The 49 has 3 ports available. 500K of ram is split into home/port 0, and port 1; the 1-MB flash memory is called port 2. The 89 can sometimes erase your flash memory (at least it loses the filenames). AMS 2.xx recovers the names most of the time and small programs can recover the rest. If something screws up on the 49 and it deletes memory, the only memory that is affected is home/port 0. If something is messed up, a screen will pop up that asks "Try to recover memory?" or a TTRM as we affectionately call it. Most of the time this will recover the RAM, but it will fail occasionally. When it does recover RAM, the directories are usually renamed. The 49 will never lose memory in the flash memory. Port 1 is reportedly less secure, but I have yet to lose anything from it. Port 2 will never be accidentally erased.
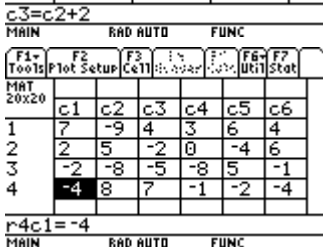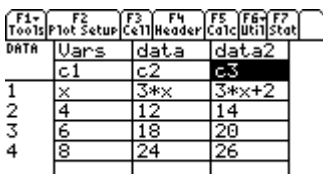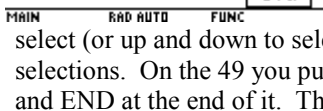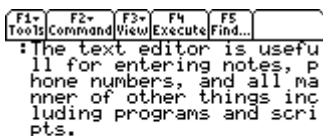
The 49 also supports nested folders, which means there can be many folders inside another folder. This is very useful for saving equations and programs in easy to remember places. Both the 89 and 49 have memory management utilities, but the 49's is easier to use. It is graphically navigated through using the arrows to enter folders and the menu buttons to sort, send, copy, rename, edit, etc. Both work well and are easy to use, the 49's is more intuitive with the arrows.

The 49 also has a neat feature called libraries. These are similar to flash apps of the 89, but can be made on the calculator.
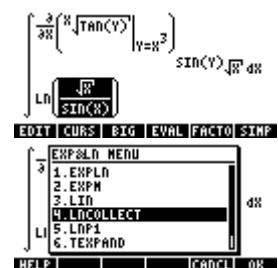
Once installed in a port, the functions or programs in the library are merged into the system. This allows access through direct calls in programs, the catalog or the command line anywhere in the calculator.

Text Editors: Both calculators have built in text editors. The 49's can be customized to remove the header with a small start-up program that is run when the editor starts (or assign a different user made editor if desired). The text editor on the 49 starts when anything besides a matrix or algebraic expression is edited while the 89's is in the APPS menu. Both have special characters and punctuation marks. Key presses from the keyboard can access many of the most common special characters.

The 49's text editor has many features missing from the 89's. Some of these include styling (bold, inverse, italic, underline), search and replace options, jumping from word to word, deleting previous/upcoming word deleting lines, ability to edit characters and changing scrolling speed. The cut/copy/paste options are directly accessed from the keyboard on both calcs. On the 89, to select text you hold the up-arrow shift and move back and forth to select (or up and down to select whole lines). This is quick for small selections. On the 49 you push BEGIN at the beginning of your selection, and END at the end of it. This is quicker for large selections.

Matrix/Data editors: Both calculators have matrix editors. The editor on the 89 has many features that aren't built into the graphical matrix editor on the 49. In addition, it allows manipulation like a spreadsheet by assigning formulas, names and such to columns. As with a spreadsheet, if you edit one column the rest will update to reflect that change. Statistical calculations can be performed upon the data inside the editor also. The 49's graphical editor doesn't have all these options, although once made and placed on the stack, you can do most of these things, but it is very difficult unless you know how. One advantage the 49 has though is the ability to pack stuff in. Even with a screen almost half the size of the 89's the 49 can pack in data using a small font. It can even go down to a 15-column width but the numbers are too close to be read easily. Anyway, let's see. . . '10x8 = 80' vs. '4x6 = 24' 80/24= 3.33 times as many numbers! Talk about using your brain to get around a problem. ;-). Summing up, the 89 has a very powerful matrix editor/spreadsheet with many advanced functions. Da' 49 don't.

Equation Writer: If I didn't have this, my life would stink. One of the nicest features built into the 49 is its equation writer. It is very fast and very easy to use. The 89 doesn't have a built in equation writer although one can be installed (more on that later). For those of you associated with the 89's equation writer these screen shots will seem familiar because they look almost identical. Any time an algebraic is edited, the equation writer loads up. When an item is put on the stack, to edit it simply press the down arrow to load the appropriate editor. Very convenient. Sub expressions can be isolated and solved, variables can be substituted for, equations written and solved. In other words it removes any need to mess with those #$!& parenthe(((())()()())))'s.

Communication: I really have no idea what format the 89 uses to communicate, all I know is that you need special graph-link software to communicate with a computer with the 89. The 49 has two communication options: Kermit or X-modem (both universal transfer formats). Kermit uses ASCII character translation or binary mode, while X-modem is, well, X-modem. Kermit is slower while X-modem is a universal high speed transfer (high speed being relative for these small devices of course, Not T-1 fast or nothing ;-) The maximum X-modem speed is 15360 baud. Translated into real language, that means I can send a 100Kb file to my calculator in just a little over a minute. Not just by using HP's special software mind you, but any x-modem transfer program like HyperTerminal. The 49 has a server mode, both Kermit/x-modem that allows another user to transfer files, receive files, upgrade the system, etc. This is very handy for transferring stuff; you don't have to mess with two calculators. From my observations the HP transfers much, much faster than the TI. Having different setting for transfering makes it more difficult for those not familiar with the calc to use it. They always change a speed setting or something and can't figure out why it doesn't transfer. Again we have here a one-size fits all approach from TI.

From here on out we start getting into murky waters. (I ask again please don't send any letters to me in which you act like an idiot; I'll read them and laugh, then delete the stupid things.) What I mean is that graphing and the CAS are the two most fought about features of the calcs. People always argue and hold up their calculator and say, "See, look what mine can do! You can't do that!/Mine's faster!/Mine is bigger!" No calculator dick wars, please. . .

Graphing: These are after all graphing calculators, so it's about time we get to this. The 89 has 10 types of graphs built in. The 49 has sixteen. Whoa! Hold on the 49 has six more types of graphs; it must be far superior! (so says Idiot Joe who knows nothing but numbers. He also thinks a 1.7 Ghz Pentium 4 is better then a 1.2 Ghz Athlon by the way;-) Hang on a minute! Don't be a fool and look at it like that. Let me finish. I'll give a list of the graph types. I'm not going to go through and discuss each graph type.
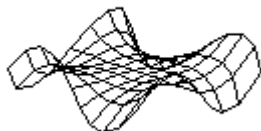
As a general rule though, the 49 graphs slower then the 89. This is not always the case though. The 89 will do some things that the 49 can't as well.
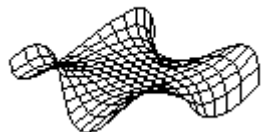
89 Graph Types
Function
Parametric
Polar
Sequence
3D
Differential Eqs.
w/slopefield
Histogram
Box Plot

Function
Polar
Parametric
Differential Eqs.
Conic
Truth
Histogram
Bar
Scatter
Slopefield
Fast-3D
Wireframe
Pseudo-Contour
Y-slice
Gridmap
Parametric-Surface

Function: At default settings, the 89 graphs quicker. Shading is also much faster on the 89. By adjusting the resolution off of each pixel, the 49 speeds up greatly while graphing, but not quicker then the 89. (Just take into account though that a TI-83 or HP-39/40 graphs faster then both these calcs, processor speed isn't everything ya' know) After graphed though, the 49 has some features lacking in the 89 that should be there. Most notably it that the 89 can't find extreema or intersections by itself. On the 49 you push root, extreema, intersection, etc. it jumps to the closest point with that criteria. On the 89 you must specify an upper and lower boundary. This is very annoying!

3D graphing: The 49 has two options for 3D: wireframe or fast 3D. Wireframe must have a window specified while fast-3D doesn't. This is one of the few instances where the 49 graphs quicker then the 89. Rotation of the graphs are much quicker and smoother on the 49, even when the grid is increased to the same size as the 89's grid. Shown are low-res/higher res on each calc with the grid sizes equal. The higher res graph took approx. 10 seconds on the 49 while it took approx. 20 seconds on the 89. The 89 will do hidden line removal and a few other options but they are slower then the movie *As Good As It Gets* (frankly, I thought that was impossible ;-).

The 49 lacks a sequence graphing utility. I myself have never used one. I've also never used most of the other graphs available on the 49. They are there if needed though. The 89 also does split screen graphing/table and the 49 doesn't.

CAS(computer algebraic system): If you want me to say right now which is better, I'll answer you. It depends. That's it. That's my answer. Now let me explain it. The differences between them can be broken down into a statement. Consider a trip. You have a destination. The 89's method is point and click. It will get you there if it can, but you have no options. The 49 will let you choose whether to drive, take a bus, which restaurants to stop at, take the scenic route, etc. Now that my lame metaphor is complete, here's the real statement. The 89's CAS is idiot proof. The 49's CAS requires some knowledge of use and where you want to go with the solution. First thing that needs to be done for a comparison is to break it into several areas of comparison.

Auto-simplification: Bottom line: the 89 does, the 49 doesn't. This is a great tool for people that don't know much about math. It's great to get "textbook" answers, but there are side effects. It takes time, and it doesn't allow the user to decide what form an answer is given in. Other problems can come up such as where a variable, say x, is defined as x^2. Auto-simplification (try this on an 89 'x | x=x+2') will keep evaluating the problem again and again until out of memory. It's not doing anything wrong, just following the auto-simplification rules built into the system. Some people really enjoy this feature. Others despise any form of it.

Step-By-Step: There is a function in the 49 that is unavailable on the 89. Many of the 49's CAS commands can be solved step-by-step, showing intermediate steps. This varies from showing simple long division to advanced calculus steps. This is useful for learning and remembering math functions. For those who wish to cheat, it also allows writing down steps on tests and such.

Built in help: The 49 provides built in help for its CAS commands. Not just a listing of syntax, but an explanation of what the function is doing, related functions that deal with the same kind of problem and an example that shows the function in action. This is very useful.

Algebra/Trig: Both calculators offer manipulation of variables. Both will isolate variables and solve for variables. The 89 will automatically simplify and divide polynomials, while the 49 has special functions to do this. Both have built in trig functions (I'm not talking cos, sin, etc. but manipulation tools), although the 89 has only two (expand & collect). The 49 allows you to choose which function in order to get back the answer you need. If the answer is given to you on the 89 as sin and cos, but say you need the answer in tangent form, or half tangent, or inverse trig form, or just cos, or just sin, or perhaps in complex form; you're out of luck. For those that don't need/care what form the answer is returned as, the 89 will work great for trig functions. The 49 does not support csc, sec and cot though.

The 49 has many more advanced mathematical functions that deal with integers, primes, modula and complex numbers that aren't available for the 89. Most people won't ever need them unless you take advanced math classes, but they are there if you do.

Calculus: The CAS (computer algebraic system) in these calculators are different. The CAS in the 89 is based on Derive, while the CAS in the 49 is based on Erable/Alg48 (user made hp48 programs). As far as I can tell from research, Derive uses a fast table lookup system to do integrals and derivatives. The 49's CAS uses algorithms to simplify things. This means that when Derive finds an answer (say when integrating), it usually finds it quick. If it can't find the solution in tables, it simplifies and modifies equations until they work out, but this can take a long, long time. However, it won't always find the solution. No CAS will always find the solution every time. For simple integrals such as in high school calculus, Derive is often faster then the 49. This is not always the case however. Here is an interesting link that timed the two against each other on different styles of problems. I don't agree with their method of declaring a winner from each area, but it is an interesting read.

http://tifaq.calc.org/ti89vshp49.pdf

The 89 has the reputation of being a lightning integrator. It is very fast at some problems that the 49 has trouble with. Some
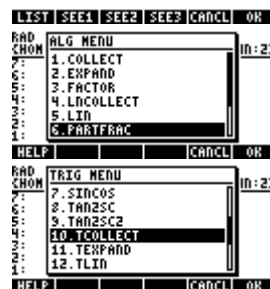
simple in-your-head integrals take a few seconds on the 49 while they are immediately solved on the 89. Many much more difficult integrals cause tremendous slowdowns on the 89. This is due to the table-based Derive engine. If the 89 can't find a solution to an integral/derivative though, it returns the equation untouched and you are stuck. On the 49, there are tools to continue the problem unavailable on the 89 including the RISCH algorithm and IBP (integration by part: remember the fundamental theorem of calculus anyone? This command is it. :-).
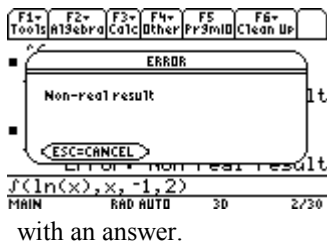
I have found though that the 49 is much smarter at dealing with problems. It will rarely fail though, but if it does, there are always tools to continue working. Take for example the integral of ln(x) evaluated from -1 to 2. Try it on an 89. You get the result on the left. The 49 asks you if you'd like to continue and then comes up with an answer.

The 89 has no dedicated series command for studying series expansions for some reason. The 49 has several dedicated funtions for series. The 89 can't solve higher than second order differential eqations with built in functions either. The 49 utilizes Laplace trasformations and inverse transformations to solve higher order differential equations.
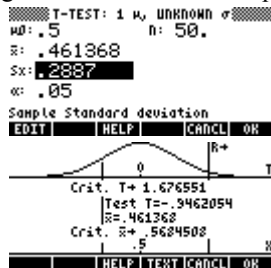
It should be noted that the 49 can do symbolic calulations with any function. The 89 can't do symbolic eingvectors/values or complex calculations with many functions.

Other 49 specific Features: The 49 has built in time functions including alarms that can initiate programs, time labs, alert appaintments, wake you up, etc. There is a small speaker in the 49 that works well as an alarm, and also opens up many interesting possibilities for music players, games, etc. There is also a fully functional financial solver, multiple equation solver and statistics package.

Programming: I've heard a complaint that HP's own comparison says that the 89 only has Basic as programming language while the 49 has Basic/RPL/Assembly. Again this is due to what can be done on the calulator. Yes, that's right. The 49 has a built in assembler/dissasembler to allow assembly programming on the calculator. I will talk about that in a little while and right now will compare basic and userRPL.

The 89 uses its own form of ti-basic. It is easy to use, easy to understand, but requires a lot of silly commands and steps. Looping on the 89 is very slow too. The 49 offers basic or userRPL as it's highest level languages. These are lower then the 89's basic though. (sidenote: when talking about levels, it means the lower you go, the closer the programming gets to machine language and the faster it is)

To program on the 89, you go to the programming area. On the 49, simply type in << >> delimiters and start programming. The 89 has a nice feature that has templates for commonly used loops, input forms and other commonly used objects that speeds up basic programming.

UserRPL is much quicker and more efficient than Ti-basic. There is also a built in debugger on the 49. Not a box that pops up and says "missing something" but a useful debugger. It's simple to use. The program is recalled on the stack, and then each command is executed and then the results are shown. This allows to see exactly what is going on in the program and find any mistakes easily. There are also built in timing facilities to time execution speed so it is easy to make small changes to get the fastest programs possible.

I'm not going to go into specifics about TI-basic/userRPL here are links to the chapters in the user guides that deal with programming. Neither is very good, but it gives

http://education.ti.com/product/pdf/gb/eng/8992p/17progrm.pdf
http://www.hp.com/calculators/techsupport/manuals/49g/english/chapter10.pdf

the general idea.

Price: The 89 has a street price of about $130-$140. The 49 has a price of about $150-$160 (although I've heard new ones are packaged with a computer cord). There are fewer stores that carry the 49 whereas you can walk into most stores and buy an 89. Both can be found for cheaper by ordering usually.

External Features

Manuals: The 49 was shipped with horrible manuals. This is explained in the first or second page by HP's *cough* environmental policy *end cough* where the goal is to reduce paper (I'm seriously not making that up). Included are basic and advanced manuals as well as a usefull pocket size quick guide. Apparently they realized the night before shipping that they forgot to write a manual for the calculator so they grabbed someone who spent the night drinking too much coffee while writing the manual. There are some really good manauls availible online, and there are some very good ones to purchase, but the manuals that come with the cacalculator are not of much use.

The manual on the 89 is much nicer, but is still not the optimal guide. This is because of the large size that discourages against portability. There are also sections of the manual that seem to talk about the same thing several times (especially the grey hints in the boxes).

The best written calculator guide I have seen so far is the guide for the HP 39/40. It is small enough to be portable yet still manages to cover everything needed to know.

Other Places For Help: There are other resources availible to receive help if one takes the time to look. The two main websites for HP and TI calculators are **www.hpcalc.org** and **www.ticalc.org**. Both have lots of information and programs availible if people look.

In terms of customer service, both companies have support for their products, although TI's is quicker at responding to questions. The 49 has built in test functions that test the display, memory and the keyboard that make it easier to track down problems if any pop up (I've never had to use it yet after almost two years).

In terms of a place to get a quick question about programming questions and other issues, HP has an active (possibly over-active) user group called comp.sys.hp48. This forum is frequented by many people willing to help new/old users alike. In addition many of the top programmers and even some of the designers of the 49 respond to questions. The easiest way to access the group is probably Google (which purchased deja.com) and has old archives up for reading. http://groups.google.com/groups?hl=en&safe=off&group=comp.sys.hp48

The advantage for the 89 is the likely-hood that someone nearby is familiar with the 89 and can help out. In the US there are usually very few HP calculators until college, and most teachers know little about them, so its harder to get help.

Emulators: There are emulators available for both calculators. Vti is the nicest calculator emulator available. Emu48 is a very nice emulator itself, but is less user friendly then Vti. Hp allows anyone to download calculator ROMS so it's easy and legal to emulate any calculator. There is also a version of Emu48 for PocketPC so calculators can be emulated on the go.

User-Made Programs

Both calculators have a large resource of user-made programs available at www.hpcalc.org and www.ticalc.org. There is one thing nice about hpcalc.org and that is that programs submitted are added within a few days barring server problems. Sometimes submitted programs on ticalc.org take months. The layouts are different and ticalc.org is a little easier to find programs and info with. Not to say hpcalc.org is hard to use, it just is a little less friendly. It has screenshots showing next to file descriptions which makes choosing programs easier though.

There are many user programs for the 89 that fix problems with the system and add features. Some of these include programs that will allow nested folders, auto-completion of parenthesis, and a wonderful equation editor very similar to the one on the 49 except it also allows lists and matrices to be edited in it. TI produces applications that allow for advanced statistics, and some programs that cost money (although I have yet to meet a person that paid for anything).

Programming: The 89 has one thing going for it the 49 does not, and that is the existence of an exceptional C compiler called TIGCC, (http://tigcc.ticalc.org/). There is a C compiler for the 49, but it isn't very good. C is the most taught language in the world, and although it isn't as effiecent as handwritten assembly, a good compiler (like TIGCC) still manages to produce fast code.

In terms of on-calc programming though, the 49 wins hands down. The built in assemler/ dissasembler is called MASD, and a variety of tools have extended its functionality to allow easy sysRPL/assembly programming. SystemRPL is a lower form of userRPL and is what much of the ROM is programmed in. It is a very rich language and has over 3000 commands. Each is 2.5 bytes and using it allows very fast and efficient programms.

Programming on the 49 is one of the funnest programming experiences availible. This is because its incredibly easy to get into anything and look at code. A program called Nosy allows easy dissasembly of anything on the calculator including any part of the system. In a few simple steps, it's possible to get into the assembly code of the system.

There is also a fantastic editor available called Emacs (no not what you're thinking, just the same name) that does such things as command completion, key recording, macro language, templates, diagrams of commands and other features that make programming on-calc even easier.

There is another editor ported from the 48 called Jazz. Jazz is a complete compiler/dissasembler and offers even more options and features including assembly/sysRPL debuggers.

User-made utilities allow customization of the calculator to the extreem. There are programs availivble that allow re-organization of the units menu and addition of user-made units, customizing the application box, changing the stack header to show free memory and more details, changing the library menu and just about everything else possible. There is even a key management utility that allows keys to be assigned with double-click and long press just like a mouse. It also allows different keys to act different ways when an edit line is active. My catalog button defaults to the built in if there is no edit line, and if there is, it limits the catalog to just commands starting with what I've typed.

I have my keyboard re-arranged how I like it. My programming tools, editors and favorite programs are assigned for quick access at any time. Assignments like dissasemble on a long click, and assemble on a double-click allow even more options for speedy programming and autocomplete on another primary button I don't use while programming (like the catalog button).

The 49 also has small programs that can compress code on the calculator. These programs can make self decompressing objects similar to .zip files allowing easy compression of programs and data.
Games: There are fantastic games for both these calculators. The 89's larger screen makes a big difference for games, but good programming can lessen that effect on the 49. Both calculators have a library of games including tetris, zelda, puzzle games, arcade games, etc. Grab an emulator and try them out. Many are really good and lots of fun. Just don't forget that these are math tools, not just glorified gameboys as some would have you think.

Wrapping It All Up

Finally done. I ask again for input from anyone who has read this so I can correct any errors I've made while writing this. If you feel I've left something out feel free to drop me an e-mail at timwessman@yahoo.com.

In conclusion, I hope you've learned a little something you didn't know before. If so I've succeded in my goal. Thanks for spending some time reading my ramblings.