A Real Comparison Between
the TI-83+ and the HP-39/40G

I'm writing this comparison not to set out and show that one calculator is superior, but to show the strengths and weaknesses of each. I haven't found a comparison between these two calculators on the Internet, so I've set out to write one. It is a natural comparison because both are aimed at the same market (high school students) and fall into the same price range. I intend 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 at timwessman@calc.org.

The format to be used for the rest of this document will be as follows:-

- A comparison of built in features of the calculators.

    Why only built in features first? This is because the average user doesn't own a computer to calculator cable. Most of us reading this will be die-hard calculator nerds (in a positive way! :-), who 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 use any sort of tally system to come out with a "winner".

- External factors such as support, manuals and user written programs including games.

    Once the average user has advanced beyond simply producing graphs and solving equations these external factors can make a huge difference. For example, many schools may base their recommendations to students on factors such as these. Certainly an experienced user will be interested in what extra 'bells and whistles' his or her calculator may provide access to. Many students also would like to know about what games are available on their calculator.

In an effort to provide good details, I will be using many screenshots and examples. I have carefully checked my information and conclusions, but it is, of course, unlikely to be completely correct. 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. Since my little sister owns one, I am more familiar with the 39 and will be able to explain its function in much more in depth than the 83. I'll try to explain everything as well as I possibly can.

Why compare the TI-83+ with both the HP39G & the HP40G?

Wait a minute! That's not fair! Why are you comparing a TI-83+ with two different calculators? Why not compare an 83 SE or other models? For those not familiar with the models concerned, let me provide some background.

The HP39G is sold in America and Australia, while the HP40G is sold in Europe. There are essentially marketing reasons behind this. Teachers in Europe disliked the infra-red (IR) data transferring ability of the HP38G (the ancestor of the HP39G and HP40G). So they would either make students tape over the IR on their HP calculators, or ban such calculators completely. They believed that students would use IR to cheat

during tests. This demonstrates a lack of understanding more than anything else because the calculators have to be less than 4 inches (8-10 cm) apart to transfer. I think they'd probably get caught. Don't you? ;-)

In view of this marketing problem Hewlett Packard decided to market two almost identical calculators. HP used the same hardware base the HP49G is built on (with a few important modifications!) and made the HP39/40G. The HP39G has IR capability, while the HP40G has a computer algebra system, or CAS, instead (more on that later). Teachers in the USA don't like calculators with a CAS because they feel that students learn more thoroughly if the calculator does not "do it for them". So basically it means no CAS for the USA, and no IR for Europe. Other than this, the calculators are identical, including the ROMs. So the 39 has the CAS hidden in its guts, you just can't use it.

The reason I chose to compare an 83+ instead of an 83 or 83 SE is simple. The 83 SE is an "I-Mac" version of the 83+ attempting to mix the memory of a 49 (1.5 MB) with the abilities of an 83, plus a battery eating over-clocked Z80 chip. It is also costs about US$130. It is designed for an 83 "power user". The 39G is essentially an upgraded 38G (although the system code almost totally different), while the 83+ is an upgraded 83. In view of this, it seemed natural to compare them. Plus the 83+ (very sad pun intended) is, in my view, now more common than the 83. For the rest of this document, I will refer to the 83+ as an 83 because I hate typing more than I have to, and the 39/40 as a 39 except when specifically discussing the 40. Most of the 83+ information pertains equally to the 83, and the same for the HP's. Anyway, without further ado, here we go.

A First Look
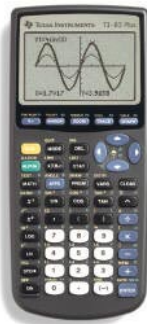
Left and right respectively are small pictures of the TI-83+ and the HP39G calculators. As you can see, the 83 followed a traditional coloration scheme by using a black case, green and yellow shift buttons and some blue keys for functions, arrows and F keys. In contrast, HP decided to abandon all tradition (except tradition set by the 49G, if you can call it tradition) and go for a dark metallic blue with light blue shift keys and orange for alpha. This results in a high contrast keyboard that is easy to read. Which coloration scheme is 'better' is a matter of preference. In my experience however, most high school students like the bright colors. My sister has received comments that her calculator was "awesome". One of the funniest comments is always "What kind of TI is that?" :-)

Many of the "old school" HP users dislike the new coloration on the 49/39. As most high school students like bright colors though, and the 39 is aimed at that market; this was a wise decision. The 83 has a black case while the 39 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 39 appears to be larger (due to soft curved edges that trick the eye). In reality they are almost identical size. The 83 weighs less than the 39, 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 39 on both the bottom of the calculator and on the sliding case. The 83 has two rubber feet on the bottom of the calculator, and four on its case. The 39 seems to be less prone to slipping off a desk or book due to these extra feet.

Power

Opening the battery case on the back reveals a difference. The 83 has four AAA batteries and a small watch battery to retain user memory while changing batteries. The 39 uses only three triple A's and has no backup battery. The 39 uses an internal capacitor to retain memory while changing batteries, but if the batteries are not replaced within approximately 5 minutes the RAM can be wiped. In both cases, of course, losing the

user memory will not affect the normal abilities of the calculator as these are 'hardwired' into the ROM chip. Both calculators will run for quite a long time after displaying a low battery message.

Keyboard Comparison

The 39 appears to have fewer keys than the 83 because they are smaller, but actually has one extra key in the top row of "F" keys (called soft keys or menu keys on the 39). Both calculators have about the same number of functions available directly from the keyboard, but more of these are math functions on the 39's keyboard as opposed to simply functions involved in the normal operation of the calculator. Both calculators have two shift modes. One of these gives access to extra functions and the other is an 'alpha' mode which allows typing of alphabetic characters. Both appear 'cluttered' to the same extent.

The layouts of the keyboards are very similar. The biggest difference between them is that the 39 has its shift and alpha keys at the lower left, while the 83's shift keys are found at the upper left of the keyboard. The 39 keyboard gives direct access to integration, differentiation and natural log functions, which is useful in calculus. Both calculators automatically insert the closing parenthesis and delimiters. Both calculators must be switched out of alpha mode in order to type numbers or math symbols. There is a problem with pushing the same key too fast on the 39. It waits a tiny second to prevent accidental double-presses, so when entering two numbers in a row like 33 or 155 it may miss the second key-press of the same key if you type too fast. A 'fix' for this problem is in the works, but is not yet publicly available. When it is though, it will be in the form of an extra aplet available at the web site "The HP38/39G HOME view" at http://members.iinet.net.au/~ccroft.

The keys on the 39 are slightly harder to press. The 39 has rubber keys, not plastic, so it feels quite different than most other calculators. Some like the feel; others despise it. I don't really mind.

Screen
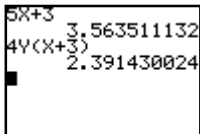
The first thing easily noticed is that the 39 has a screen cover on it. This screen cover doesn't scratch easily and protects well against damage. It also has little or no reflection unlike early screen covers on the HP49G. The screen size is about the same on the two calculators.
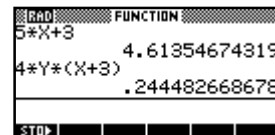
The resolution on the 39 is 131x64 and on the 83 is 96x64. This means that the screen resolution on the 39 is almost a third again wider then the screen on the 83 and translates into a larger area for graphing, games and viewable history display. The 39's history display has a small status bar at the top that gives the current apple (see later) and the current angle mode. There is also an entry or editing line at the bottom of the screen. The 83 has nothing except an empty screen and a blinking cursor which, as you can see, allows for almost four complete calculations to fit on one screen.

An important feature of the 39 is the provision of context related extra functions via soft-key menus at the bottom of some screens. The unlabelled buttons immediately below the screens can then access these. TI has followed Casio and HP's lead on this as later calculators, starting with the 85, have this feature The 83 has no "menu" buttons whereas on the HP they are often permanently visible. On a graphing screen they can be removed to show more of the graph.
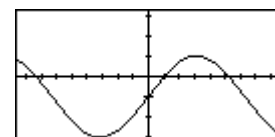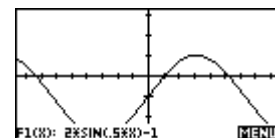
<u>**Built In Features**</u>

Both calculators have an impressive list of functions and features. The 39 has over 600 built in functions; the 83 has about 400. HP's strategy in building the 39 was to include everything an average high school or

early college student would need in a calculator, and then to make it as user-friendly as possible. In order to do this, they threw out HP's traditional Reverse Polish Notation (RPN) and instead used algebraic entry. Although the HP49 offers both types of entry, the 39 is strictly algebraic.

What is an Aplet?

HP's main strategy in making their machines more user friendly in the 38G and again in the 39 has been to use the aplet. Although an aplet is essentially a small program dedicated to one function, it can be better thought of as an operating environment. First introduced on the 38G in 1995, HP has renamed them to e-lessons (electronic-lessons) on the 39 in an attempt to attract younger users by sounding cool (or something :-). There is no difference between an e-lesson and an aplet.

The concept behind an aplet is this: if the student wants to do something with a function, use the Function aplet (or Polar or Parametric). If they want to graph a sequence, use the Sequence aplet. If they want to solve a problem using statistics then use either the Statistics or Inference aplets. This makes it very easy to use because each program or environment is dedicated to one thing, provides special tools specific to that type of function or application, and is independent of all other aplets in its graph and function settings. You get the picture.

In addition, you can save a built in aplet, giving it a new name, and thus saving any data in it separate from the original aplet. This means you can save a Statistics aplet with data you want to keep or a Solve aplet with some physics equations in order to expand the number of equations or lists you can normally have at one time. In this document I will call them aplets because e-lesson is too long.

Aplets can also be sent to other 39's using the IR link. This means that if you have used your Statistics aplet to store and analyse some data you can save it under a new name and send it to a friend. Teachers can also use IR in this way to send aplets containing pre-prepared data or functions to their class. If you have the necessary cable you can also save aplets onto a PC or Mac.

What's the Difference between Aplets and Flash Apps?

The ability to run Flash Apps was introduced in the 83+ in 1999. A flash-app is a program installed in flash memory that has a specific purpose or ability. Some apps change the language of the calculator and add international characters, some are designed to teach concepts, one adds conic graphing, etc. Many of them actually have to be purchased from TI to be used. Wait a second! Programs installed in memory, dedicated to one function, integrated into the system, stored in a separate location . . . this seems a lot like an aplet! Could it be that TI . . . . . <thinking>. . . . . . .<thinking very hard>. . . . . nevermind (*wink-wink*). :-P

Memory

 Both these calculators have a lot of memory as compared to their earlier counterparts. The 83 has 24K ram and 160K of archive flash memory. The 39 has 234K of RAM but no flash memory. Because of this, memory on the 39 is less secure. Perhaps an indicatio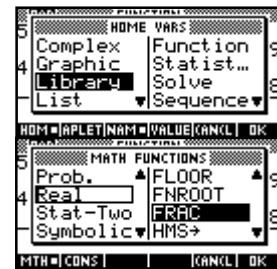n on how secure this is though is that my little sister has been running hers for almost a year and has yet to lose anything. The flash memory in the 83 is secure against accidental erasure and system resets. The 39 has more memory overall than the 83. Both have memory management utilities, but the one on the 39 is more visually appealing. Instead of showing just sizes, it gives a percentage of total memory being used. I have found by direct comparison of similar objects on the calculators (storing identical matrices, lists, numbers, etc.) that memory management on the 39 is much more efficient in some areas but less in others. Just as a small example: a 4*4 matrix stored in both calculators fits in the 83 as 152 bytes, and 130 bytes on the 39. Not much of a difference until you start getting larger items, but then the gap widens and it does make a difference.

The 83 has upgradable ROM to fix things and add improvements (but for improvements . . . there arguably haven't been any as of yet). The 39 isn't upgradable. This is because the hardware is the same as the 49, so people could just re-flash it with a 49's ROM and get a really cheap calculator. . .

Menus

These calculators both use menus to access commands. On the 83 you have to use the menu to access commands as commands are written in lowercase and you're unable to type those on the 83. The menus on the 83 are inefficient. Once you memorize the number or letter of a command, access is quick but it takes a long time to learn them all ;-). The 39 has all the commands grouped together according to their function. They can also be typed directly and all are uppercase. The menus are accessed by scrolling up or down (or by hitting the first letter of the category to jump to it) and then moving over into a sub-menu to access the actual commands. The 83 has a catalog that lists all functions alphabetically, but the 39 doesn't. It's easier to find which command you need in the new category menu system on the 39, but an alphabetical catalog still should have been included just for good measure.

Basic Calculations
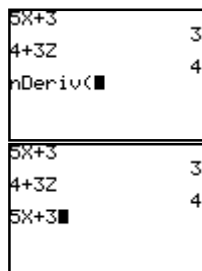
As stated earlier, the 39 is an algebraic entry calculator. This means the traditionalist HP people are annoyed, but high school students can use it easily. Typing in calculations and functions is similar on both so I won't go over boring details (both do implied multiplication, etc).

The usability of the calculation history is another thing. The 39 is very easy and quick to use. To recall previous calculations or entries, the 83 allows you to push 2nd [ENTRY] repeatedly to recall the entries, although it doesn't allow you to recall the answers to them beyond the last entry. The 39 has what is called an interactive history, and it allows just that. To access the history, just use the up-arrow to move to what you want to copy into the editline. Unless wiped to conserve memory, all previous calculations and their results are stored in this scrolling history list. The 83 keeps something like 120 entries (more than enough), but it's a pain to get to them. Pasting of an expression from the history into the edit-line can also be done in the middle of a current expression, whereas the 83 overwrites anything in the editline. You also can't see the previous entry if it is off screen, whereas the 39 allows you to scroll up and find it or any answer you need. This interactive history is a very, very, very, very, nice feature on the 39. It speeds up calculations immensely. Look at the pics on the right to see it being used to paste 5*X+3 into a new calculation.
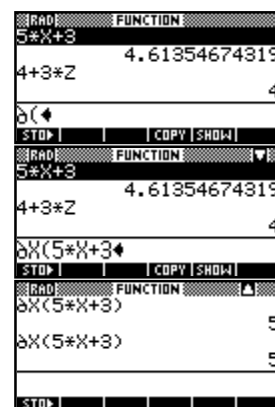
Viewing Objects

The 39 also does "pretty print", (oops, I can't say that…. TI has it copyrighted) errrrr... I mean textbook mode ;-). It doesn't show things in the history in textbook mode, but if you scroll up using the interactive history and push [SHOW] it shows it as it would be written in correct mathematical format. This is useful to make sure you didn't mess up a large equation with the parenthe(()())'s. This also works in all the aplets to let you check your equations. Take a look at the example. Nice huh? :o) Equations which are too large for the screen can be scrolled using the arrow keys.
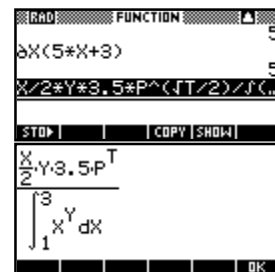
Text Editors

I should say editor <singular> as the 83 has no dedicated text editor (although by saving text or other items in a string, notes and text can be saved). The program editor is almost a text editor, but that will be covered later. The 39, on the other hand, has a good text editor. It's called the Notepad, and allows the user to type and save notes, as well as to transfer them to another calculator via IR, or to a computer if you have the necessary cable. The note catalog shows how much space each note is taking in memory, and allows you to transfer notes to another calculator or a PC by pushing [SEND] or [RECV] directly from the note browser.
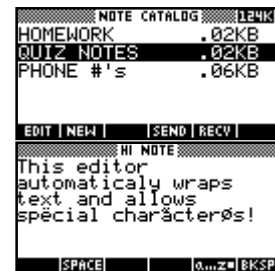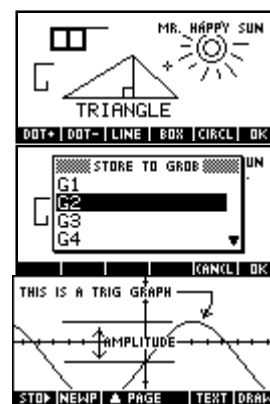
Graphical Editors

Both these calculators will edit pictures, but the 83's editor is only active while graphing. You can use it to edit a plain screen by turning off labels and axes and then pushing [GRAPH] but unfortunately it takes time to do so. This does allow easy labeling and adding extra information on graphs though.
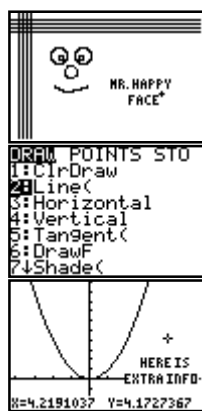
The 39 doesn't allow direct drawing on a graph because it uses a different solution. Each aplet on the 39 comes with a note and a sketch attached to it. The aplet note isn't the same as the notepad, although the abilities are the same. They are saved in completely separate locations with the main difference being that the sketch and aplet note are sent automatically with an aplet when it's transferred. This allows customization of aplets with extra useful learning information or instructions. The sketch allows the user to edit pictures with line, box, circle and freehand tools, as well as allowing easy addition of text in large or small font. Push page down, and move to a new page. Pushing STO> will pop up a menu asking to which graphic variable (G0-G9) to save to if you'd like to keep your masterpiece. It's very easy! Additionally, pressing ON+PLOT in any view, including the graphing view, also allows you to capture an image of the current screen into graphic variable G0. This can then be pasted into a sketch page and edited using all the normal tools. This allows editing a graph or any other screen with extra information and details.

The graphical editor on the 83 allows for freehand, circles and text as well as for the shading of graphs. It is much slower than the graphical editor on the 39 though. For example, the 39 will draw a circle very quickly by starting at two points on either side of the circle and draw in both directions from each point. The 83 starts at a single point and draws one direction around the circle. The 39's text tool asks for the text, and then displays a box the size of the text and allows you to position the box where the text is to go. On the 83, you just kind guess how big it will be.

Matrix editors
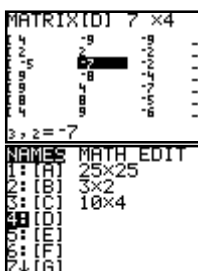
Both these calculators hold only 10 matrices apiece. One of the most annoying things on the 83's editor is that the user has to define the size of the matrix before starting to edit it. It is also unable to handle complex matrices. The matrix editor on the 39 is very fast. It will ask which type of matrix to create (see list right), and then places you into the editor. To enlarge the size just enter more numbers and it is automatically resized. You're can also insert or delete individual rows or columns. The 39's screen displays 24 numbers; three more then the maximum on an 83. The 83
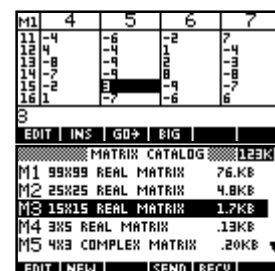
can't really handle larger matrices because the memory management seems to be poor and it runs out of memory fast. For example, a 15x15 random matrix on the 83 takes a little over 4K vs. 1.7K on the 39. A 25x25 matrix takes 11K vs. 4.8K. With only 24K RAM the 83 runs out of memory quickly.

In terms of matrix functions, the HP is equipped with several advanced matrix functions not included on the 83. This includes things like Eigenvectors/values, Least Square Decomposition and Schur Decomposition as well as others.

List Editor
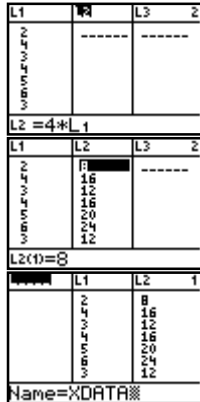
This is where the 83 scores really well. While only L1-L6 are built in lists, the 83 allows the user to name and save lists thus allowing many more. It also allows formulas (such as L1*4) to be entered on the name of a list in the editor to make a list quickly from another list.

Side note: the 39 really has two list editors. One is the list editor (L0-L9) and the other is the statistics editor (C0-C9). The stats editor is actually much more like the list editor on the 83.

The 39 won't allow calculations in the list editor. To do this, you must go to the HOME view, enter the formula and store it into the another list, and then push shift-LIST or NUM to get back to the list. The List editor is very slow in entering numbers. The Stats editor is the same speed as the one on the 83 while scrolling around. For some reason though, it slows down slightly when entering numbers. Both have similar options such as sorting or assigning frequencies built into them.
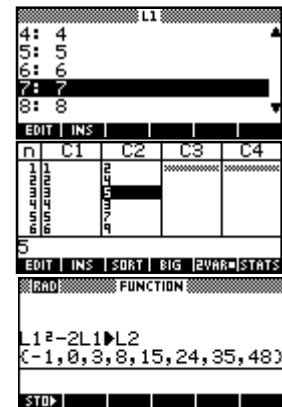
Financial Solver

The 83 has a built in financial functions that do interest, amortization, etc. The 39 has no built in financial solver, but it is easy to save a copy of the Solve aplet and then enter the financial equations to solve. I have yet to ever see anyone use this on either calculator, but it's there if you need it.

On-Calc Help

The 39 has a function called HELPWITH. Push shift-2 to enter the command HELPWITH (or type it in alpha mode), enter a function (minus any opening parenthesis) and push ENTER. The result is a pop up message box that lists syntax for the function. Not extremely useful as the result is not in plain English and does not come with an example, but it is enough to enable the user to get all the correct arguments if they don't remember. In the HP-40G the CAS with the HELPWITH command does give worked examples and it is sad that this was not included in all uses.

Communication
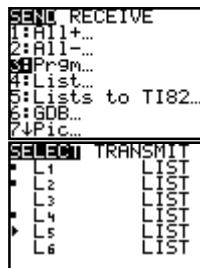
Both these calculators have PC/Mac versions of their communication kits as optional extras, although the Mac version for the 39 is well out of date and HP have no plans to upgrade it. The 39 has IR communication built in and so it doesn't come with a calc to calc cord. The 40G, on the other hand, comes with a calc to calc cord since it does not allow IR.

The 83 communicates with a format particular to TI calculators. I'm not exactly sure what the name of this is called, but it basically works like this. The sending calculator/computer waits for a message from the receiver before sending the next block of data. When sending from calculator to calculator, the speed seems to be about 9600 cps (characters

per second). From the computer to calculator, the speed depends on the speed of the computer as well as which type of cord is used. This can result in a wide variety of speeds. I have received reports ranging from 1.5 KB a second up to 25 KB a second. Either way, it is fast enough to not cause an uncomfortable wait while things download.

The 39 uses a combination of Kermit and X-modem to communicate, although some very large aplets (mainly games) are designed to be transferred by X-modem only. Aplets that have no linked programs can be transferred using X-modem, but those with programs linked to them must be downloaded using the other format. When using X-modem, the 39 transmits around 2 KB a second. Otherwise it seems to transmit at about 9600 cps. Both calculators have no special options to cause confusion when transferring files, so it is easy to use. The 39 allows you to send and receive from each object editor or in the aplet view, while on the 83 you go to a specific file transferring view to send or receive files.

A nice feature about the 39 is that any calculator can be used with an overhead display unit. The 83 requires a special calulator that has a large ungainly plug in the back. The 10-pin connector of the 39 uses 6 of the pins for the overhead unit. This allows students to get up and show work, not just the teacher.
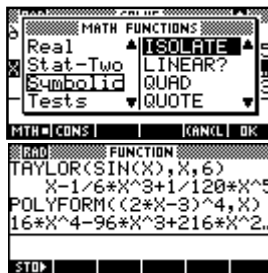
Equation Solvers

Both calculators have an equation solver, but the solver on the 39 is more versatile. The solver on the 83 is limited to solving an equation set equal to zero. You can also only have one equation saved at a time. On the 39, you simply type an equation into the Solve aplet, change to the NUM (numeric) view, enter all but one value and push SOLVE. Very n ice! It also doesn't need to have boundaries defined as the 83 does, and can plot values to graphically show possible solutions. In addition, you can have up to 10 equations saved in the Solve aplet. You can't solve for more than one at a time, but it's very easy to switch equations. This is very useful for physics, or anything else with lots of equations. Just save a copy of the Solve aplet and call it "Linear Motion" or something, enter any relevant equations and then choose which equation to solve when you need it.
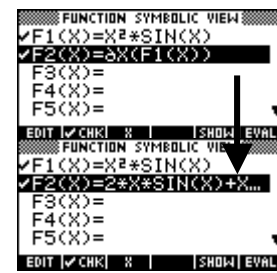
Symbolic Manipulation

The 39 has a small symbolic capability. It allows you to isolate variables providing that the variable only occurs once in the equation, substitute values for a variable and symbolically solve a quadratic equation.

In addition, it will differentiate symbolically, and symbolically solve some simple integrals and Taylor polynomials.

You can also use these abilities in aplets such as the Function aplet by typing in dx(F1(X)) and then evaluating it using the EVAL key (see right).

Overall though, the capabilities of the 39 do not remotely approximate those of a true CAS system such as is found on the HP40G or TI-89. This means that it is suitable for tests like the ACT that don't allow symbolic calculators.

Polynomial Functions
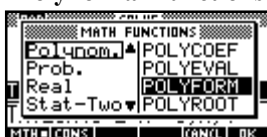
The 39 has several functions designed to manipulate polynomials. These will solve for coefficients given roots, or vice-versa, evaluate a polynomial given the coefficients and symbolically expand a polynomial from an equation (see above).

Graphing

These are after all, graphing calculators, so it's about time to start this. Both calculators have about the same graphing ability. This includes function, parametric, polar, sequence, histograms/bar, box-whisker and scatter capabilities. The 83 also has a normal probability graph which the 39 doesn't.

To graph on the 39, it's necessary to start the specific aplet for that type of graph. All the setting for that graph are easily accessed by using the setup views for the SYMB, PLOT, or NUM views. On the 83 all the options are in one or two menus. This causes problems when students try to graph one type of plot, but accidentally have a statistics plot on, so it graphs both. This happens so much that it is quite funny to watch, especially during a graphing lecture. ;-) However it can also be an advantage to be able to display graphs of different types on the same axes. On the 39, if the Function aplet is active, then that is the only type of equation that can be graphed. It is more difficult to display graphs of different types on the same axes and requires overlaying two PLOT views.

The 39 allows either 'Detail' or 'Fast' graphing. The fast setting plots a point only at every second pixel, which can result in jagged graphs if the graph has asymptotes or the like. The Fast setting on the 39 is similar in speed to the 83, but because of the higher resolution (and extra columns of pixels) it takes slightly longer to finish. Both have options such as drawing a grid, shading, finding roots, extreme, etc.

One of the most annoying things about graphing on the 83, or any other TI calculator, is that you must specify an upper and lower boundary for finding roots or extreme. On the 39, or any other HP calculator, you simply push the root button, and it finds the closest root to the current cursor position. This saves lots of time. On the 39 you can also scroll off the screen and it will draw a little more of the graph.

Split Screen
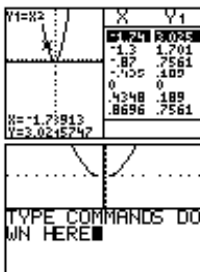
Both these calculators have split screen, and both have one form of split screen the other lacks. The 83 has a horizontal split so you can enter commands and functions, while the 39 has a zoomed plot. The 83's split allows for labeling the graph and entering commands, while the mode on the 39 lets you zoom in and out, and then copy the zoomed area into the main window. I've never used or liked split screen views so this doesn't affect me much, but to those that do, it may be an important factor.
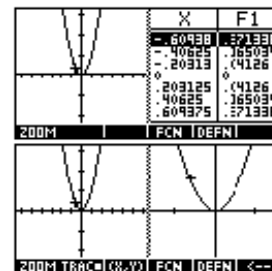
Statistics Plots
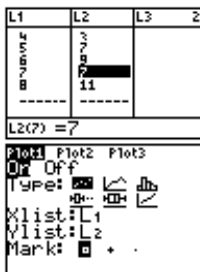
Both calculators have statistics plots, and the 83 has a normal probability plot the 39 lacks. The 39 allows for five different plots at once and allows five different styles of dots for scatter plots versus the 83's three types of dots and three plots. The options for plotting are also all together so you can change each graph at the same time instead of separately like on the 83. The statistics graphs on each behave the same, so there isn't any large differences to discuss here.
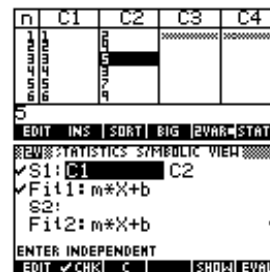
A nice thing about the 39 is that it is very quick and easy to change regressions and turn them on or off just by pushing FIT. On the 83, it in necessary to assign the equation to a Y variable while calculating it in order to plot it.
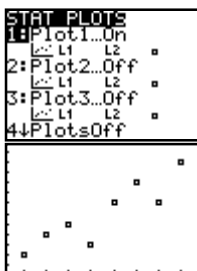
One nice feature of both calculators is that once the regression line has been drawn the user can move the cursor along it and see the predicted y values. Using the GOTO key on the 39 students can even predict y values not even on the axes displayed.

All the usual summary statistics are available on request on both calculators. The 83 will not give correlation or variance unless the diagnostics are turned on using **diagnosticOn**.
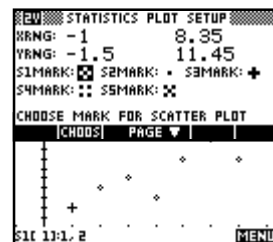
CAS (computer algebraic system: 40G only)

The 40G is equipped with a CAS and equation writer. Unfortunately the only way to get one in the USA is to import it, or have a friend bring you one from a vaction. The 40G's CAS is essentially the same as the one in the 49G (ROM revison 1.19-1) but changed slightly for an algebraic calculator. There are a few commands missing from the 40G such as DOMAIN, but almost everything is there. For a more detailed explanation of the CAS, look at my TI-89/HP-49 comparison as I go into much more detail in that document.

In summary: In order use the 40's CAS effectively, some knowledge of equations and of where you want to go with the solution is required. It doesn't automatically simplify things and allows the user to decide what form to put the answer in. Many of the 40's CAS commands can be evaluated step-by-step, showing intermediate working. This varies from showing simple long division to advanced calculus steps and is useful for learning and remembering math functions. For those who wish to cheat, it also allows the recording of steps on tests and such.
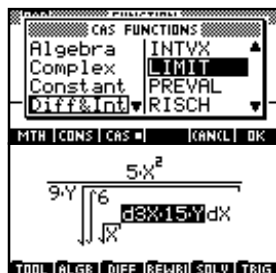

The 40G has built in help for its CAS commands utilizing the HELPWITH function again. As mentioned earlier, this is not just a listing of syntax, but an explanation of what the function is doing, related functions that deal with the same kind of problem and an example that shows the function in action. This is very useful. So what kind of problems will it solve? Every type of problem the 49G will solve.

For those who feel that it isn't really fair comparing the 40G to an 83, and that the 40G should be compared to the 89 or something, my answer is . . . you really can't. The 89 is at least $50 more expensive and aimed at higher math students. The 40G is in the price range of an 83, and aimed at the high school market. Having equal or greater symbolic capabilities than an 89 doesn't change that.

Statistics
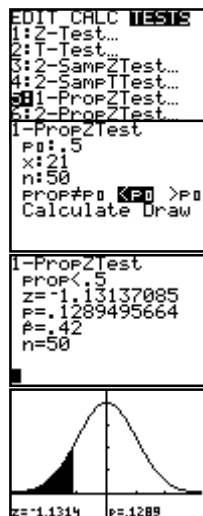
The 83 is often touted as the only apropriate calculator for non-calculus based statistics. While the 83 does have the greatest "statistical" ability ;-), both calculators have advanced statistics functions. The 83 has many "advanced" statistics functions that solve cumulative probability and distributions. These can be more efficiently solved in the 39 by entering an equation such as **UTPN(M, S^2,X)=P** into the Solve aplet. This allows solving for any value of the normal distribution (mean, standard deviation, test value and probability) in a quick and easy way without using different functions for each. It also allows solving inverses of each funciton, some of which the 83 won't do.


The 39 has an Inference aplet that handles inferential statistics. The tests are all grouped together for quick, easy access and are easy to understand. It is also quicker to do multiple tests because you don't need to restart the test each time you run it.
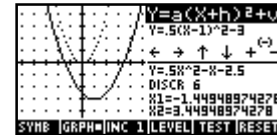
The 83 has similar inferential functions, but they give less information and are accessed using the 83 style menus, making access slower. The 83 does however, have built in functions to graph and shade statistic distributions that the 39 lacks. It also has a few regression equations not in the 39, and has built in ANOVA and Chi^2 functions.

The 39 has a Chi^2 probability command as one of its built-in functions, but not as part of an aplet. BASIC programs on the 39 will add ANOVA and more advanced Chi^2, but they will be slower than the 83's built in functions. Summing it up, either calculator will perform well for non-calculus based statistics; the 83 has more functions built in.

Learning Aplets
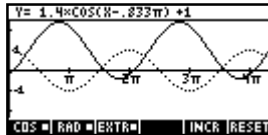
The 39 has some built in "learning aplets" that help teach concepts. The two built in learning aplets are the Quadratic Explorer and Trig Explorer. This is an example of how an aplet can be used to teach a mathematical concept. Students can transform trig. graphs and quadratics in real time, see how the values change and then test themselves on the concept. A really neat idea for helping teach! Most kids would probably prefer if they could be deleted for more space for games, but alas! That isn't possible. ;-)

Programming

Both these calculators have a version of BASIC. TI-basic is (suprisingly ;-) on the 83. HP has what is called HP-basic, or uRPL, on the 39. It is actually a modifed version of Rocky Mountain Basic that HP had on some old computers. There are only minor differences between the two BASIC languages. These differences are the names of the commands and the lack of GOTO commands on the 39. Antother difference is that on the 39, commands and arguments are separated using ; between arguments and : to end a command.

```
:FnOff
:ClrDraw
:PlotsOff
:AxesOff
:0→Xmin
:1→Xmax
:0→Ymin
:1→Ymax
:rand→X
:rand→Y
:For(K,1,3000)
:rand→N
:If N≤1/3
:Then
:.5→X
:.5Y→Y
:End
:If  1/3<N  and
N≤2/3
:Then
:.5(.5+X)→X
:.5(1+Y)→Y
:End
:If 2/3<N
:Then
:.5(1+X)→X
:.5Y→ Y
:End
:Pt-On(X,Y)
:End
:StorePic 6
```
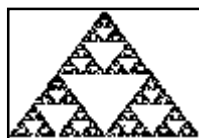
The editor on the 83 is a specific program editor. Each line is one command and has a colon before it. The editor on the 39 has nothing except the usual soft key menu strip and a blank screen. It looks identical to the note editor. Commands are executed in the order they appear and do not have to be on separate lines. It is very easy to program on both calculators, although the syntax on the 39 takes a little to get used to because of the ; and : between arguments. It is very easy to translate one program to the other language. Take the programs on the next page that draw a Sierpeinski Triangles. I got this from the 83 guidebook. I like this program because it does something neat with a short program. See if you can guess programming language is which! ;-P The point is, both of the languages are very similar, and both are very easy to use.

The first time a program runs on the 39, it takes a while to start. This is because it is being checked for syntax, and copied into a faster machine code version so it will run faster. This is not required on the 83 because the programming editor does not store the program in text form, but instead translates as it goes. The problem with the 39's approach is that the program is essentially saved twice, so it is much larger than it should be. On the 39 the small program displayed here takes up about .87K once run. On the 83 its about .15K. This is a big, big difference. In this case, the 39 is very inefficent at saving something. On the other hand, because the file is simply text it can be edited very easily.

```
0→Xmin:
1→Xmax:
0→Ymin:
1→Ymax :
RANDOM→X:
RANDOM→Y:
FOR K=1 TO 3000
STEP 1;
RANDOM→N:
IF N≤1/3 THEN
.5→X:
.5Y→Y:
END:
IF  1/3<N  AND
N≤2/3 THEN
.5(.5+X)→X:
.5(1+Y)→Y:
END:
IF 2/3<N THEN
.5(1+X)→X:
.5Y→ Y:
END:
PIXON X;Y:
END:
DISPLAY→ G6:
```

If memory runs low, its easy to just push [EDIT] on the program. This will restore it to its smaller size (which in this case is about .24K), but it's still larger than on the 83. Kudos to the 83 on this! Shame on the 39!

What your program is for though will influence which calculator it is smaller on. With the 39's extra commands, some programs will end up smaller because of commands that handle complicated functions; this is the exception however, not the rule. The best method for programming on the 39 (aside from assembly or sysRPL on a computer), is to customize copies of the built in aplets to do what you need, linking any required programs to the aplet. The result can be very fast, very small and very powerful. Many of the teaching aplets which are available on the internet take this approach.

A nice feature about programming on the 39 is that you can save a small program as a template in the program catalog. Then any time you need (for example) If..THEN…ELSE, just access it through the vars menu, and you can pull the IF. . .THEN. . .END statement into your program to save time. This can be done with choose boxes, display routines or any other frequently used command routines.

Other Features

The 39 has a small speaker inside it. This presents interesting opertunities for games and music applications. The calculator does not beep on errors fortunately but the user can't turn sound off in the GUI. So while playing games, unless the game itself has a sound ON/OFF setting, it may cause the calculator to beep at you sometimes and give away the fact that you're not listening to that math lesson! ;-)

Price

The 83 has a street price of about $90-$100 (US). It can be bought almost anywhere. The 39 can be found for about $75-$80 (US), but usually must be ordered online. This adds shipping, so depending on how much the shipping costs, the final price is about $90 (US). If the 39 is bought at a local store though, it will probably be cheaper than an 83.

External Features

Manuals

The 39's manual is the best calculator manual I have ever seen. It isn't too large (about 300 pages), but everything is easy to understand. The manual gives an explanation of all commands, and explains them well. The quick-reference guide is a 50 page book that quickly runs through most of the aplets on the calcuator and has lots of examples.

The 83's manual is 500 pages long, very detailed, but is a little too large to be carried easily. It has many examples and lots of information, but there is a limit on what size a manual should be. A reference guide has no limit; a manual however, should be detailed, yet small enough to not be a hassle to pack around.

Other Places For Help

There are other resources available as sources of 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 available 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 39 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 on any of my calculators in almost seven years).

There is a fabulous website dedicated to the 39G that has an excellent FAQ. The owner is named Colin Croft. He teaches in Australia and helped redesign the user interface when HP was making the 39. The address is http://members.iinet.net.au/~ccroft/. If you still can't get an answer, there's always comp.sys.hp48 (easily accessed at groups.google.com), but that is more for the 48/49G than the 39. You can always e-mail Colin or I too. I'll answer questions if I know the answer, and he will most likely know any that I don't.

The big advantage for the 83 is the likely-hood that someone nearby is familiar with the 83 and can help out. Most teachers are familiar with it, and will probably be able to help. In the US there are usually very few HP calculators in use until college, and most teachers know little about them, so it's harder to get help.

Emulators

There are emulators available for both calculators. Virtual-TI 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. If you'd like to look at a 39/40 in action then either go to Colin Croft's Utility page (at http://members.iinet.net.au/~ccroft/) to download a complete package or simply download this file (http://www.hpcalc.org/hp39/pc/emu48-39.zip). Included is a ROM that allows you to switch between the 39 or 40. To activate the 40G, select that KML script, push the second menu key from the left, and then hold ON and push the third menu button from the left. This activates the CAS and its menus. The package obtainable from Colin's site contains separate emulators for the 39 and 40, which makes things slightly easier.

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 very quickly barring server problems. Programs submitted on ticalc.org take longer. My 89/49 comparison took about 2 weeks to be added. 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. Hpcalc.org lacks a news section or discussion areas like ticalc.org, but does allow users to rank programs and add comments to them.

In the case of the 39 there is an additional large (>50) set of additional teaching aplets and programs available from Colin Croft's web site (see previous page). These are all free and many contain accompanying worksheets that can be copied freely and used in the classroom.

There are aplets for the 83 that fix problems and add language support. An application that gives conic graphing is available, as well as some other functions. There are applications TI produces that that cost money (although I have yet to meet a person that has paid for any of them).

It is worth checking out these sites, as the extra resources provided by these user-made programs are worthwhile. As an example, consider the screens taken from various 39 aplets shown right.
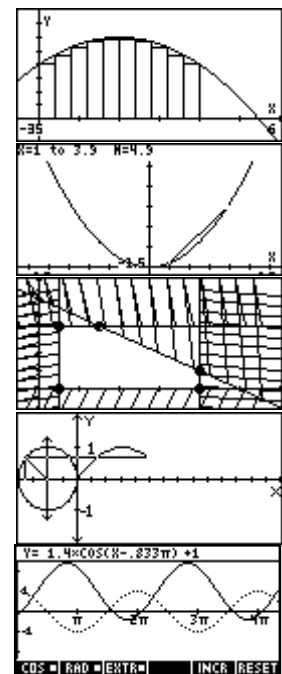
TI has several very good free apps available at http://education.ti.com/. Some of these include language-specific help, flash cards, conic graphing, a function explorer and programs to teach algebra topics. Just out of curiosity, look at this. Compare the two bottom screen shots of a TI learning apllication and the built-in trig explorer on the 39. Very suspicious. . . . isn't it? ;-)

Games

Everyone always talks about how many games are available for the 83. This is true. There are many more games available for the 83 than the 39. The problem is that many are not very good. There are less games availible for the 39, but in terms of quality games. . . . almost all of the games for the 39 are quality games.

This is because the hardware is identical to the 49 so developers may release a version for the 39 at the same time as they release it for the 49 because it requires very little conversion. Shown are screenshots from several games just so you can compare them. The 39's higher resolution allows for more detailed games, and the speaker allows sound effects. I've gone into this games section in much more depth because many 83 owners buy them for availible games more than anything else. Just don't forget that these are math tools, not just glorified gameboys as some would have you think. ;-)

Now I'm just comparing assembly games because frankly, there aren't any BASIC games for the 39 (partly because of the memory problem with basic programs on the 39). These aplet games however, are very compact and efficient.
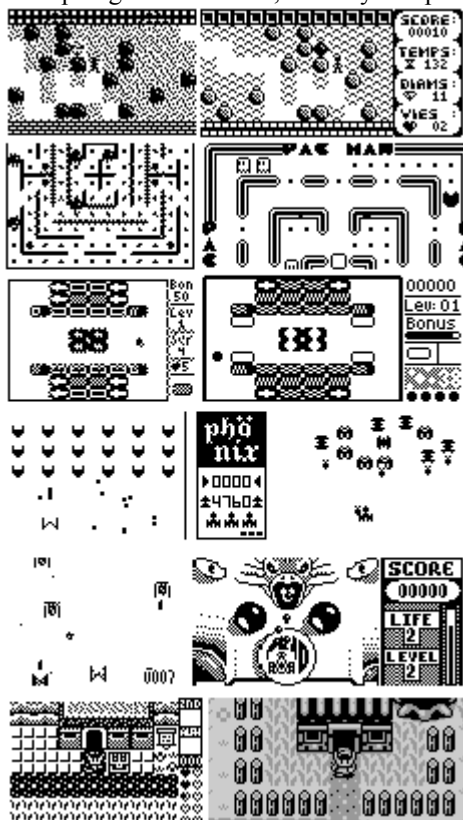
There are some excellent BASIC games for the 83 (especially some massive RPG's), but many of them are slow or text based games. On the 83 you must run a "shell" that gets around TI's limit that prevents large assembly programs from running. I guess they thought that if people could do something useful they wouldn't buy TI's programs. . . ;-)

These are just a few examples of games, but as you can see by comparing the similar programs, the 39 ones are usually more advanced. Phoenix for the 83 is an excellent game that has taken its toll on many math grades over the years, and there are many other great 83 games. There are many very impressive games for the 39 though too. Zelda is very advanced, very fast, and has the smoothest animation I've ever seen on a calculator. There's a version of worms; not the snake game, but the worms with bazookas! And what is that? DUNE 2? On a calculator!?! Yup. ;o)

The point is that quantity isn't everything. I personally would rather play a high quality game than a quantity game. With the addition of a larger screen and sound, the 39 is very capable of entertaining you during dull classes; just remember to turn the sound off first . . . ;-)
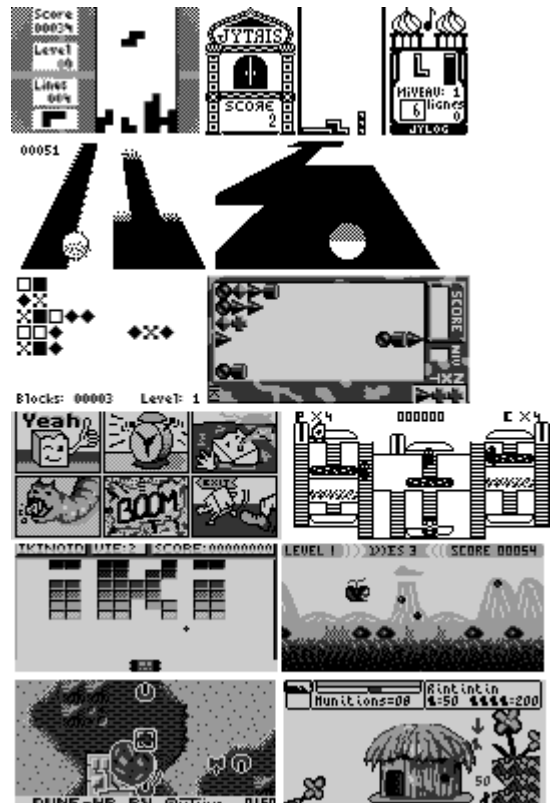
Wrapping It All Up (and a little editorial)

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@calc.org.

Judging from my experience, the 39 is by far the easiest calculator to use. This comes from observations and coments by many 83 owners that have used my 39. They were always amazed at the ease of use, having heard that HP's were so hard to use. It is so easy that my mother has actually been able to use it and graph things WITHOUT reading the manual! This is the same lady who has problems turning on a computer. I'm not saying trash your 83 and run out and buy a 39 (although I wouldn't stop you if you wanted to do so ;-). The 83 is a great calculator that will serve its purpose well. What I mean is . . . I hope you've noticed the same thing while reading this as I noticed while writing it. The 39 is a very capable and advanced calculator at a VERY respectable price. Despite what TI would like you to beleive, there are more calculators availible besides the 83 that will perform well for high school and early college. HP's latest calculator will excell during this time period. Don't just buy something for the sake of buying it, try them both out and decide which one you like better.

If you live in the USA and ever have the chance to buy a 40G, do it! Even if you don't want it, you can find someone on E-bay who will. For the price you can't get a more capable calculator.

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.