The Magazine
with New Solutions
for Hewlett-Packard
Calculators

hpc

Hewlett-Packard Calculators

April 2000 Vol. 6 No. 2

In This Issue...

hp^c Hewlett-Packard Calculators

In This Issue

Editor's Note

Forgetting About the Tools

Ask any craftsman or mechanic what makes a good tool, and you're likely to get an answer something like this: The best tools perform as simply and precisely as extensions of yourself—your hands, your arms, your eyes. And our preferences for our everyday tools reflect this, even the high-tech: Individual computers didn't really catch on until we could use a pointing device (mouse) and a graphical interface (menus, windows), rather than character codes, to run them. Why is this? Because we want to concentrate on the task at hand, not be distracted by the operational details of the tool. Otherwise, the labor-saving value of the tool is lost.

What about our many tools that aren't, by their nature, so ergonomically intuitive? They're still plenty handy, of course, once we learn their operations well enough to form them into ***habits****. We wouldn't say that a car is a natural extension of the body's own locomotion system, but we can readily train ourselves to the point that we need not give much conscious thought to the mechanics of the controls while driving. Again,* ***we forget about the tool****.*

What does this have to do with HP's new calculators? Plenty. Nobody would argue that a calculator is an extension of one's hand (...yet). But with every new HP design, the interface becomes more intuitive (and the "driver's ed" course shorter and simpler)—exactly what students need. So check out the new family-friendly HP models 30S and 39G, now on the show-room floor. And bring the kids. With calcs like these to drive, they won't be taking a back seat to anyone.

hp^c is published three times annually for Hewlett-Packard Company by Grapevine Publications, Inc.
P.O. Box 2449
Corvallis, OR 97339-2449

For subscriptions, corrections, letters to the editors, and information on submitting articles or other materials, please see page 52 and the inside back cover.

Production Editor **Chris Coffin** is author or co-author of some 30 instruction books. He is CEO of Grapevine Publications, a Corvallis, Oregon, publisher of plain-English books on technology since 1983.
E-mail chris@read-gpi.com
or phone 541.754.0583.

Technical Editor **Dianne Hart** is a math instructor at Linn-Benton Community College in Albany, Oregon. Since 1990, she has conducted teachers' workshops on the effective use of HP graphic calculators.
E-mail hartd@gw.lbcc.cc.or.us
or phone 541.917.4627.

TAPE HERE (DO NOT STAPLE)

TAPE HERE (DO NOT STAPLE)

(Tear or cut along perforation)

STAY IN TOUCH

❑ Please change (or correct) the address in my subscription to *hp*^{c}.

❑ Please start a new (FREE) subscription to *hp*^{c}.

Name: _____

School or institution: _____

School or institution address: _____

City: _____ State/Province: _____ ZIP/Postal Code: _____

Country: _____ Phone: (_____)_____

Fax: (_____)_____ e-Mail: _____

Mailing address (if different than above): _____

City: _____ State/Province: _____ ZIP/Postal Code: _____

Country: _____ Phone: (_____)_____

Math course(s) currently teaching: _____

Age/Grade Level: ❑ Elementary ❑ Middle ❑ High school ❑ 2-year college ❑ 4-year college

Do you use graphing calculators in class? ❑ Yes ❑ No

If so, what models? ❑ HP ❑ TI ❑ Sharp ❑ Casio ❑ Other: _____

If not, do you plan to begin using them? ❑ within 6 months ❑ within 12 months ❑ beyond 12 months

To respond via e-mail, please send the above information to: **hp@bbs.mlc.pdx.edu**

To mail this form in the U.S., please fold it on the solid line below, tape in places indicated (please, no staples) and mail (no postage needed).

Non-U.S. residents: Please use an envelope and affix proper postage—or fax this form to 503-370-7961.

(FOLD) (FOLD)

(Tear or cut along perforation)

(Tear or cut along perforation)

(Tear or cut along perforation)

THE MATH LEARNING CENTER
HEWLETT-PACKARD EDUCATOR PROGRAM
PO BOX 3226
SALEM OR 97302-9832

POSTAGE WILL BE PAID BY ADDRESSEE

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 101 CORVALLIS OR

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

TAPE HERE (DO NOT STAPLE)

TAPE HERE (DO NOT STAPLE)

Smarter, simpler, slimmer – a wily combination

Cool New Calcs!

Today's designs, tomorrow's results

With teachers in an endless battle for students' time and attention, up steps Hewlett-Packard with a timely (and time-tested) solution: If hammering at the front gate doesn't open it, maybe the right intrigue will. That's what's offered by these sleek new machines from HP: powerful teaching and calculating tools, disguised in seriously cool packages. Boredom is history—and this time, Troy wins, too.

The HP 39G

No other calculator makes learning math so natural. The HP 39G features E-lessons (also called ApLets), an expanded set of built-in tools adapted from topics in textbooks, packaged to help students learn faster and get more from class and homework. And the HP 39G connects directly to a personal computer or overhead display, so students can see your keystrokes or share theirs.

The HP 39G simply makes math make sense. It shows the calculation and the result. It shows expressions in textbook format. It shows mathematical relationships numerically, graphically and symbolically—split-screen views for side-by-side comparisons to drive home the concept.

This machine equips and entices students to open their own inquiries, with some 600 easy-to-find functions: Equation solving, expansion, substitution, function analysis, plotting, tracing, zooming, differentiation, integration, linear systems, matrices (real and complex), summary and inferential statistics—and programming to automate and customize.

Learning adventures beckon.

The HP 30S

Here's an educator's dream team any way you look at it—playing at a middle school near you: With smarts for today's demanding classes, style for today's discerning students, and a price for today's depleted budgets, the HP 30S sets a new mark in combining value, power and convenience in one sleek package. Teachers will like the tools and kids will like the looks (interchangeable colored faceplates—2 extra with each calculator)! It's a whole new ball game: win-win.

With 250 functions, 10 memory registers, and the ability to evaluate expressions in multiple variables, the HP 30S gives students plenty of room to maneuver as they crunch numbers and solve problems. They get all the usual math features, plus equation solver, statistics, unit conversions and physical constants—homework-ready for a wide variety of subjects in math and science.

Learning by doing—by *wanting* to see: With machines this intriguing, the math might sink in without students' even noticing. They'll be too busy having fun and looking good.

Teachers Assess HP's Newest Calculators

HP 39G:
Upgrade to First Class

By Michael Grasse

User friendliness, multiple views and ApLets were the hallmarks of the HP 38G, and if you liked it, you will love the new HP 39G. It offers a host of improvements over the 38G, without losing those essential features. Sure, it looks different in its new case and keyboard, but it's built solidly on the HP 38G's functional foundation. Here's a quick summary of the most significant upgrades:

Memory: The 39G comes with 240 KB of memory for storing ApLets (now called E-lessons), programs and data—a big improvement over the HP 38G's 17 KB. And the HP 39G offers better memory management, too: You can see how much memory is still available and how much is being used by ApLets, programs, notes, and other data types.

Key layout: With four more keys on the HP 39G, more commands are available directly from the keyboard—and the keys are reorganized to make them easier to find.

E-lessons (ApLets): The HP 39G offers more: The popular Trig Explorer and Quad Explorer ApLets are now built-in.

Statistics: Two-variable summary statistics now include population covariance, sample covariance, and relative error. For inferential statistics, which the HP 38G didn't offer at all, you get confidence intervals and hypothesis testing (via ApLet), inferences for one or two means (based on normal or t-distributions), and inferences for proportion data.

Plotting: You can now trace directly on a curve fit to a scatterplot—also on just the data points. And in most of the plot environments, a GOTO command lets you jump to a specific input value (very handy), and then other commands, such as SLOPE, use the coordinates of that GOTO, rather than the nearest pixel coordinates.

In short, there's a lot to like about the HP 39G: all the best of the HP 38G, plus the above. And with the optional accessories available (overhead display, data collector and connectivity to PC's), it's a complete classroom solution.

Michael Grasse teaches AP Calculus and is the Computer Co-coordinator at Elk Grove High School in Elk Grove Village, IL. He has taught HP graphing calculator workshops across the U.S. and in Singapore.

HP 30S:
Smart, Stylish, Thrifty

by Colin Croft

With technology leaving its mark on seemingly every facet of life these days, it's refreshing to see a company remember the human factor, such as with the HP 30S calculator.

Already aesthetically pleasing and "human-friendly" right out of the box, this model goes a step farther by including colorful, exchangeable faceplates. It's actually designed from the start to be individualized by each user, with all the teen appeal you could wish for. It's a small but savvy nod to the image concerns of today's middle schoolers: If they like to use it, they'll use it more—and more effectively.

The HP 30S's style points don't come at the expense of utility and power, though. Clearly it's been designed with the calculator user in mind, too: large, soft-edged, generously-spaced keys on the clean, colorful keyboard. Students will see and understand more in the two-line display, which includes an editable command history and a smart constant mode to save keystrokes.

The HP 30S impresses the user as a very intuitive machine. Students enter operators and data in the order they use to solve the problem on paper. It can handle fractions as well as decimals, even converting decimals to fractions, and also converts between a variety of metric and imperial units.

Along with the usual sets of arithmetic, trig, roots, powers and log functions, the HP 30S also offers percentage, percentage change, polar/rectangular conversions and univariate and bivariate statistics. An impressive feature is the ability to recall and easily edit any statistical data. And don't overlook the two built-in equation solvers, where students can quickly solve problems such as quadratic and simultaneous linear equations without tedious calculations.

All this, plus great looks—and what a price! The HP 30S is sure to be a fixture in middle school classes ranging from General Math and Pre-Algebra to Geometry, Trig, Statistics, Physical Science, Biology and Chemistry. What works for students, works for learning.

Colin Croft has been a math teacher at St. Hilda's Anglican School for Girls in Western Australia for the past 12 years. In addition to other math texts, he is the author of many ApLets and a book on the HP 38G, and he maintains an HP 38G user's web page. Colin is currently serving as a consultant for Hewlett-Packard.

hp.com/go/math

A Community of Educators Meets Online

Welcome! Pull up a chair and share

Come In and Get Acquainted

Did you know? There's a place you can go to meet and chat with other educators, colleagues and anyone else who's interested in the educational world of HP calculators. This is just an informal community get-together site, with a variety of topics and forum spaces to share them.

hp.com/go/math

Drop by and sit a spell.

E-Lessons for All

Want to know more about HP's E-lessons? Or are you an E-lesson veteran with ideas and knowledge to share? Either way, come into this forum and work with other teachers, students and HP Experts to get the most from these great applications!

Subject Forums

Choose the math subject area that suits your interests and talk to your peers or to HP Experts about how to best apply the calculators:

Pre-Algebra	Algebra
Trigonometry	Geometry
Pre-Calculus	Calculus

The Teachers' Lounge

Have you come up with a new way to use an HP calculator in the classroom? Looking for ways to spice up your lessons? Join this discussion forum to exchange ideas, anecdotes or problems and solutions. Fill your cup, relax and do a little networking.

Trade tips, share stories, chat with experts—
or just sit on the porch and listen.

It all happens at ***hp.com/go/math***
You don't even need to bring a covered dish.

Calc Skills Study Hall

Just pick a calculator and come on in. Hone your skills, clear up misconceptions, learn handy tips and shortcuts—Q & A galore:

- HP 6S and HP 30S
- HP 38G and HP 39G
- HP 48G Series and HP 49G

Student Hangout

Need a study break? Found a cool use for your HP calculator? Want to program games into it? Come on in and share your ideas.

NO TEACHERS ALLOWED
(THIS MEANS YOU!)

Don't Be a Stranger

The Educators' Community Site is where we can all get to know each other by name, and there's a lot of good stuff to share and pass around, so be sure to introduce yourself. You can get news via e-mail, too—see page 52!

News Flash ... ... Double Bonus Points

The rumor is true: HP is ***doubling*** the normal redemption points on purchases of certain calculators. See page 28.

Customized Help, Too: Your Topics, Your Speed, Your Schedule

Summer Workshops Scheduled

This summer, The Math Learning Center is conducting a series of three low-cost calculator workshops, underwritten by Hewlett-Packard. Graduate credit is offered for the 2-day sessions, and every participant will receive a free HP calculator and workshop packet.

Workshop schedules are shown here. The sites or sessions marked with a * have not yet been finalized. Updated details are posted on the MLC website: **www.mlc.pdx.edu**

HP 39G: Graphic Calculators and Mathematics Instruction

Mth 810 1 (quarter-hour) graduate credit
Fee: $40

Graphic calculators play a significant role in the vision of school mathematics proposed in the NCTM Standards 2000. See how the multiple representation approach (tabular, graphic, and algebraic) has become an organizational feature in the generation of graphic calculators such as the HP 39G. Participate in hands-on investigations of functions, parametric equations, polar plotting, discrete mathematics, and statistics.

July 10-11	El Paso, TX	July 26-27	Los Angeles, CA
July 10-11	Miami, FL	July 31-Aug 1	Golden, CO
July 13-14	Baltimore, MD	July 31-Aug 1	Milwaukee, WI
July 19-20	San Jose, CA	Aug 8-9	Portland, OR
July 24-25	Boston, MA	Aug 14-15	Chicago, IL

HP 49G: Mathematics Instruction with CAS Calculators

Mth 810 1 (quarter-hour) graduate credit
Fee: $50

The newest generation of graphing calculators, such as the powerful HP 49G, incorporate full-fledged Computer Algebra Systems (CAS). The numeric, graphic, and symbolic toolkit provided by such calculators permits an expanded multiple representation approach to the study of mathematics. Participate in hands-on activities that demonstrate how CAS calculators can be used to teach statistics, precalculus, and calculus.

July 12-13	Miami, FL	Aug 2-3	Golden, CO
July 17-18	San Jose, CA	Aug 2-3	Milwaukee, WI
July 24-25	Los Angeles, CA	Aug 16-17	Chicago, IL
July 26-27	Boston, MA	*	Portland, OR

Proportional Reasoning Investigations Using HP Scientific Calculators, Middle School

One day (non-credit)
Fee: $25

Proportional reasoning investigations using the new HP 30S (or HP 6S) scientific calculator integrate NCTM's content and process standards for middle school. Explore all five content standards using hands-on problem-solving activities that show how proportional reasoning has real-world applications. See how calculators can be integrated into everyday classroom activities.

July 14	Miami, FL	July 31	Boise, ID
July 17	Atlanta, GA	Aug 3	San Jose, CA
July 19	Ft. Collins, CO	*	Baltimore, MD
July 25	Corvallis, OR	*	Boston, MA
July 26	Portland, OR	*	Chicago, IL

Besides workshops, keep in mind that there's also plenty of other help, year-round, for educators using HP calculators.

See the contact information for **The Math Learning Center** on page 5, opposite.

Arranging Workshops for Other Schedules

These workshops may also be arranged on an as-needed basis, to better fit attendees' schedules. Also adjustable are the workshop format, length, skill level and emphasis. HP and The Math Learning Center can custom-tailor presentations on any HP calculators. To inquire, contact:

Darrell F. Clukey, The Math Learning Center
Portland State University
P.O. Box 9278, Portland, OR 97207
Phone: 503-725-4896 or 800-547-8887 x4896
Fax: 503-725-3021
E-mail: clukeyd@pdx.edu

How to Contact HP

Why?

- If your calculator needs repair.
- If you don't understand something in the manuals.
- If you want to locate an HP retailer near you.
- If you want to learn more about HP products.

Where?

Phone:

Argentina	54 (11) 4787.7100	00.800.888.1030 *(sin costo)*
Brasil	55 (11) 822.5565	0800.157751 *(sin costo)*
Canada	1.970.392.1001	
Chile	(56) 2.800.360.999	
Colombia	(57) 1.629.5030	
Mexico	(52) 5258.4044	01.800.900.7200 *(sin costo)*
Peru	(51) 1.222.6600	
Puerto Rico	(78) 7.289.8900	
U.S.	1.970.392.1001	
Venezuela	(58) 2.800.47888	
Latin America	1.305.267.4220	
(for countries not listed above)		

Internet:

www.hp.com/calculators *(North America)*
www.hp.com/latinamerica *(Latin America)*

When?

Phone:

U.S./Canada: 8 am - 5 pm Pacific Time
Latin America: *(hours vary by country)*

Internet:

Anytime!

Educators!

Keep in mind the HP Educators Program at:

The Math Learning Center (MLC)
P.O. Box 3226
Salem, OR 97302-0226

Phone: 800.750.8130 (8-5 PT, M-F, U.S./Canada)
Fax: 503.370.7961
E-mail: hp@bbs.mlc.pdx.edu
hphelp@bbs.mlc.pdx.edu

Rolling the Dice

Histograms and Probability with the HP 39G

By Michael Grasse

When you gather data from one kind of measurement (say, the heights of your friends), this is one-variable data. There are many ways to look at a collection of such data. You could just look at the whole list, but if it's long or disorganized, it might not tell you much. You could also make various graphs based on the data. Graphs are an excellent way to display statistical information because they can contain a lot—and convey it quickly. Sometimes a graph will reveal information (e.g. statistical trends) that you would never see just by looking at the list of data.

A histogram is one useful type of graph for analyzing one-variable data. On its horizontal axis, it displays all possible values of the variable; on its vertical axis, it shows the number of times that a given experimental value falls within a particular interval. In this activity, you'll make and interpret several histograms, so you'll see clearly how useful they can be in representing the data.

The variable you will be measuring here is the sum showing as a result of rolling a pair of dice. You'll gather the data of 50 rolls.

Turn on the calculator, press [APLET] and choose the Statistics Aplet. You will now be in the numerical view. You should see several columns labeled C1, C2, etc. (If there are any data in these columns, you may want to clear them—press [SHIFT][CLEAR]. You'll be asked whether you want to clear a single column or all columns, choose ALL and press OK.) Next, check that EDIT is showing on the menu line. (If not, press EDIT to change it.) Now, using the arrow keys, highlight the first entry in column C1. You are ready to start recording data.

Roll two dice and type the sum of the two dice into the calculator followed by [ENTER]. You should see the number you entered as the first entry of C1; the second entry of C1 should now be highlighted. Continue rolling and entering until you have filled up 50 entries in C1 with the sums of the rolls.

1. What are the largest and smallest values that you have recorded?

2. What are the largest and smallest possible values for this data?

Now press [SHIFT]SETUP[PLOT]. The STATPLOT field should be set at Hist. If it isn't, highlight the STATPLOT field and press CHOOS. In the list presented, use the arrow keys to highlight Histogram and press OK. Then highlight the HWIDTH field and type [1] [ENTER].

Teacher Notes

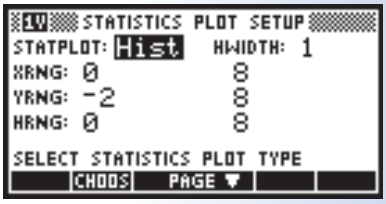
Research suggests that, before instruction, students have an impoverished view of statistical concepts such as sample space and randomness. Vague notions of luck and other psychological factors lead to particularly glaring misconceptions about statistical situations.

In this activity, students collect data, construct a histogram using technology (grappling with issues of scale), and analyze the data in terms of sample space and likelihood of outcomes. They will contrast the notions of theoretical vs. experimental probability, leading them to examine the concept of randomness.

The activity is suitable for a wide range of ages and math abilities—with appropriate levels of teacher intervention.

Placing students into groups is highly recommended. Each group will need a pair of dice (preferably of unique color) and an HP 39G. Little familiarity is assumed for the calculator. In fact, this activity could be the students' first experience of the one-variable descriptive statistical capabilities of the HP 39G.

Continue likewise, setting the rest of the fields on the screen as shown here (right). Then notice the double-wide menu key, PAGE ▼, indicating another screen of information. To get to that second screen, press PAGE ▼. There, be sure that XTICK and YTICK are both set to 1, and that the AXES field is the only one checked.



You're now ready to look at your histogram. Just press PLOT and it should appear. It probably doesn't tell the whole story, because the plot setup is not appropriate for the data. (Telling you to set the plot up incorrectly may seem like a dirty trick, but it's a good way to learn about the various settings.)

To adjust the setup, press [SHIFT]SETUP PLOT. Try changing the horizontal axis first: Set the larger XRNG value to 13, then replot the histogram (i.e. press PLOT).

The screen widens, but some of the data is likely still missing, because the XRNG setting determines only the width of the screen, not the interval of the data to be plotted. That interval is controlled by the HRNG setting. Press [SHIFT]SETUP PLOT again, change the larger HRNG value to 13 and replot the histogram....

That's starting to look better, but if a particular dice sum appeared in the data more than 8 times, its bar will extend beyond the top of the screen. You need to adjust the vertical view, increasing the larger value of the YRNG in the plot setup. Try a value of 10 for this and replot.... If any of the bars reach the very top of the screen, try 11.... Keep increasing until there's a small amount of space above the tallest bar.

Important note: If students are not seeing any histogram or are getting error messages, go to the SYMB view (press SYMB) and make sure that the H1 field is checked and has C1 in it.

You should now have an excellent looking histogram of your data.

Notice the letters and numbers along the bottom of the screen. They probably look some thing like this: H1:[0..1) F:0

The H1 means that you're using data assigned to H1 (designated in the SYMBolic area of the Statistics ApLet). The strange expression [0..1) is very important. This is a concise way of saying that you're examining all rolls whose sum is *greater than or equal to* 0 but *less than* 1. A square bracket indicates inclusion in the interval (so 0 is included); a parenthesis indicates exclusion (so 1 is excluded).

The number of dice sums that fall in the interval [0..1) is called the frequency of that interval, indicated on the screen by the F:0. You can see that there were no rolls that resulted in a sum of 0—no surprises there. But now press ▶ once and you should see the bottom information change to this: H1:[1..2) F:0

3. What dice roll sum is represented by the interval [1..2)? Is this roll possible? Why or why not?

(continued on page 8)

Table 1	
Dice Sum	**Frequency**
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Table 2	
Dice Sum	**Possible Outcomes**
2	(1,1)
3	(1,2), (2,1)
4	
5	
6	
7	
8	
9	
10	
11	
12	

Solutions to Selected Exercises

2. *Dice roll sums vary between 2 and 12, inclusive.*
3. *Only the dice sum of 1 is represented in the interval [1..2), and since no two-dice roll can sum to 1, that frequency must be 0.*
5. *The mode is the **value** of the most common dice sum, not its frequency.*
6. *A dice sum of 7 can occur in 6 ways: (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1).*
7. *Experimental results usually show a dice sum of 7 to be the most common, but due to the random nature of experiment, this is never assured. This issue leads into a discussion of probability; students often have difficulty articulating an answer here.*

(continued from page 7)

4. Continue in this way and fill in Table 1, at left, with the frequencies of all the dice sums in this experiment.

5. In any experiment, the outcome that occurs the most often is called the mode. Here that would be the dice sum with the highest frequency. What is the mode in this experiment, and what is its frequency?

Stop and consider a moment: How many ways can a pair of dice be rolled to get a sum of 2? Only one way—a 1 on each die, an outcome symbolized as (1, 1).

How many ways can the dice be rolled to sum to 3? *Two* ways: a 1 on die A and a 2 on die B, or vice versa. The set of two outcomes are therefore (1, 2), (2, 1).

Fill in the rest of Table 2, at left, showing the outcome set for each possible dice sum. The entries for dice sums 2 and 3 are done for you.

6. Which dice sum can occur in the most ways?

7. Does your answer for question 6 match your answer for question 5? Why is it likely?

8. How many different outcomes are possible in a roll of two dice?

Each of the different dice rolls are equally likely to happen, but some of the dice roll sums are more likely than others because they can happen in more than one way. This leads to the following two definitions:

If an event can result in many different equally likely outcomes, the theoretical probability of a particular outcome (called a favorable outcome) is given by:

$$\textbf{\textit{Theoretical}}\ \text{probability} = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$$

If an experiment consists of many trials, the experimental probability of a particular outcome is given by:

$$\textbf{\textit{Experimental}}\ \text{probability} = \frac{\text{Number of favorable trials}}{\text{Total number of trials}}$$

For this activity, Table 2 will help you compute theoretical probabilities. Table 1 and/or your histogram will help you compute experimental probabilities.

9. Now compute both the theoretical and experimental (i.e. based on your data) probabilities for all possible dice sums, and fill in the table to compare:

Dice Sum	Theoretical Probability	Experimental Probability
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

10. What is the sum of all of the theoretical probabilities?

11. What is the sum of all of the experimental probabilities?

12. What is the theoretical probability of rolling a dice roll sum that is less than 7?

13. Based on your data, what is the experimental probability of rolling a dice roll sum that is less than 7?

14. What is the theoretical probability of rolling doubles with two dice?

15. Suppose that an experiment was conducted with 1500 trials, about how many dice roll sums of 7 would you expect? Explain your answer.

16. Write a short paragraph explaining why the experimental and theoretical probabilities are not the same for every outcome.

17. Suppose the data from an experiment indicated an experimental probability of 0.4 for rolling a dice roll sum of 4. Which of these three is the most likely?

a. The experiment consisted of 10 trials.
b. The experiment consisted of 100 trials.
c. It is equally likely to have this result with 10 or 100 trials.

Write a paragraph explaining your answers.

This article was excerpted from "Better Views of Mathematics," a book of curriculum ideas for the HP 39G, available from HP through the HP Educator Program at The Math Learning Center. (See page 5 for full details on how to contact MLC to acquire this book.)

Michael Grasse teaches AP Calculus and is the Computer Co-coordinator at Elk Grove High School in Elk Grove Village, IL. A 1993 grant awardee in the Calculus Connections Project, he has taught HP graphing calculator workshops across the U.S. and in Singapore. Michael enjoys camping, photography and beer making. He lives with his wife, Nicolle, and dog, Scout, in Des Plaines, IL.

8. *36*

10. *1*

11. *1*

12. *15/36 ≈ 0.417*

14. *6/36 = 1/6 ≈ 0.167*

15. *The answer involves multiplying the theoretical probability by the number of trials: (1/6)(1500) = 250*

But read students' responses closely. They'll often place more faith in experimental than theoretical probabilities—and compute accordingly. This may indicate an undeveloped concept of randomness.

16. *These probabilities should not be expected to come out the same, because experiment is by nature random. This is a re-examination of the issues of randomness in question* **7**.

17. *It is more likely to have this unusual result with a smaller sample size, so the answer is A. This question was inspired by research reported by Watson and Moritz (2000). The evidence suggests that the notion that variance from theoretical expectations decreases with larger numbers of trials is not necessarily intuitive.*

Extensions

Combine groups and append the data to L1*. Make histograms of 100, 150 or 200 rolls. As the trials increase, compare the agreement between the theoretical and experimental probabilities.*

To compute the total number of possible dice roll sums, develop the concept of independent events.

To compute the theoretical probabilities for each dice roll sum, develop the concept of conditional probability and mutually exclusive events.

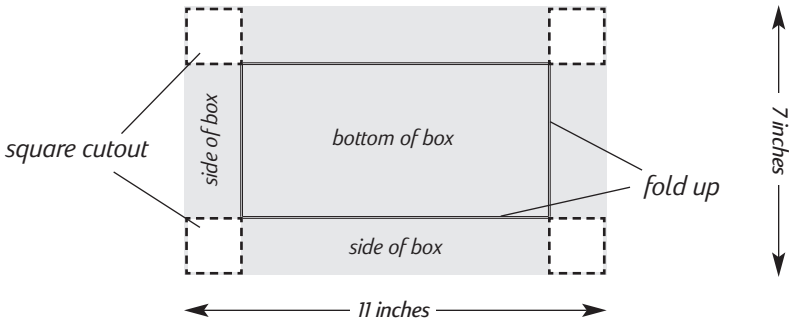
How Large Can Large Be?

Maximizing Volume with the HP 30S

By Colin Croft

Alanna's mother has asked her to help organize her younger sister's birthday party. Alanna's job is to make candy "baskets" for the guests—open-top boxes—by cutting and folding sheets of colored cardboard. Each sheet is 11" long and 7" wide, and Alanna's sister has requested that each box be formed "to hold the most candy possible." **How should Alanna cut and fold each sheet?**

To form each box, Alanna must first cut squares from each corner of the sheet:



She will then fold the resulting four tabs up to form the sides of the box.

1. It's probably obvious that the *smallest* square she can cut from each corner is 0" per side. What's the *largest* possible square? _____ Why?
_____

2. Do you think the size of the corner squares even matters for the volume of the box? _____ If so, what square size do you think will make the box with the biggest volume? _____

3. If she cuts corner squares 1" on a side, what will be the dimensions and volume of the box? L = _____ W = _____ H = _____ V = _____

4. What if Alanna cuts out corner squares of other sizes? Fill in the table:

Cut-out square side (x in)	Length (in)	Width (in)	Height (in)	Volume (in^3)
0				
0.5				
1	9	5	1	45
1.5				
2				
2.5				
3				
3.5				

Teacher Notes

In this activity, students investigate the volume of an open-top rectangular box as that volume varies with the size of the x-by-x square corner pieces cut out to form the proper shape for folding.

By experimenting with a tabular list of possible values for x, students discover that there is indeed a value which gives the maximum volume. This encourages trial and refinement to determine a more precise value—and an analytic formula for the volume: $V = x(l - 2x)(w - 2x)$

Boundary values are addressed by asking what largest and smallest values of x make physical sense in the context of the problem.

Materials needed

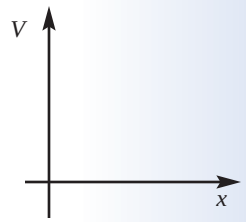
A generous supply of 11"x7" sheets of paper or paperboard, plus scissors, tape and an HP 30S (at least one per group).

Required skills and knowledge

Students must be familiar with the formula for the volume of a cuboid and be generally comfortable with solutions to equations by trial and refinement.

5. Now, after completing the table, what size corner squares do you think will make the biggest possible volume in the box? _____ in. per side.

6. On graph paper, plot the table data, showing the corner square side, x (horizontally) against the box Volume, V (vertically). Then carefully draw a *smooth* curve through the points. (Don't just join them with straight lines!)



a. What volume will result from a corner square side of 2.7"? _____ in^3

b. What corner square sides produce a box volume of 40 in^3?

_____in _____in

7. After looking at the graph, Alanna thinks the answer she got from the table is only approximately correct. Using scrap paper to do the arithmetic, help her find a better answer—accurate to one decimal place:

Corner square side = _____in. Volume of box = _____in^3.

Now, instead of using scrap paper to do the arithmetic, try using your HP 30S:

8. First, if each corner cutout square side is x, find expressions *in terms of* x for:

Box Length: L = _____

Box Width: W = _____

Box Height: H = _____

Box Volume: V = _____

9. On your HP 30S, use the X key to enter the expression for the volume, V, that you arrived at in question **8**. Then press [STO] ▶▶▶▶ ENTER, to store this into the EQN variable. To check your expression, evaluate it for X = 2: Press [VRCL] ◀▼. When prompted by the calculator, type 2 ENTER. You should get 42. (If not, get some help with your volume expression, V.)

10. Now use the EQN you have stored in your calculator to find the side of the corner cutout square for greatest box volume—accurate to 3 decimal places:

Corner square side = _____in. Volume of box = _____in^3.

This article was excerpted from "Investigating Mathematics through Patterns," a book of curriculum ideas for the HP 30S, available from HP through the HP Educator Program at The Math Learning Center. (See page 5 for full details on how to contact MLC to acquire this book.)

The author, Colin Croft, has been a math teacher at St. Hilda's Anglican School for Girls in Western Australia for the past 12 years. In addition to other math texts, he is the author of many ApLets and a book on the HP 38G, and he maintains an HP 38G user's web page. Colin is currently serving as a consultant for Hewlett-Packard.

Key concepts

Maximization/minimization of a dependent quantity through manipulation of an independent variable.

Not all solutions to a mathematical model are physically feasible.

Follow-up teaching points

Maximization and minimization studies —which of course lead to concepts in differential calculus—also suggest the use of a graphical calculator to explore local extrema visually.

Methods of trial and refinement could be further explored.

The volume formula's behavior near and beyond the problem's physical bounds would be an interesting study.

Confidence Intervals Around a Mean

Inferential Statistics on the HP 49G

By Michael Grasse

Teacher Notes

This activity may be many students' first experience with inferential statistics. It assumes a basic grasp of several statistical concepts: population and sample means and standard deviations; experience with finding areas under a standard normal distribution; and a conceptual awareness of the central limit theorem.

The reasoning behind the process of finding confidence intervals around a population mean is discussed at length before the HP 49G is used. Confidence intervals around a population mean for an unknown population standard deviation are also discussed, necessitating an introduction of the t distribution.

Materials needed

At least one HP 49G per group.

Terms introduced

Central limit theorem, confidence level, confidence interval around a mean, critical z-scores, t-score, t distribution, degrees of freedom, critical t-score.

Calculator functions introduced

Confidence intervals Z-INT: 1 μ and T-INT: 1 μ; confidence interval graphs

The Scholastic Aptitude Test for Mathematics (SAT-M) is widely used to measure readiness for college math. The test is developed and tried out on a "standardization group" to adjust the scoring so that the group mean is 500 and the standard deviation is 100. The test-taking population (all students who take the test in a given year) generally has a lower mean score. In 1991, the population mean for the SAT-M was $\mu = 474$.

The reasoning behind confidence intervals

Suppose you look at a random sample of 500 students who took the SAT-M in 1991. Are you guaranteed that the mean for this sample will be $\bar{x} = 474$? Of course not. You can expect some variability in means from sample to sample. If you took several random samples of the population, you might expect some of their means to be smaller than 474, some larger. The central limit theorem holds that means of samples of a particular size are distributed normally, regardless of the population distribution. Furthermore, if the population has a mean of μ and standard deviation of σ, then the sample mean distribution will be $N(\mu,\sigma/\sqrt{n})$, where n is the size of each of the samples.

So imagine that you took repeated random samples from the 1991 population of SAT-M test takers, computed the mean of each sample, and looked at the distribution of these means. Your variable would then be $\bar{x}$, and you should expect $\bar{x}$ to be normally distributed with a mean of 474 (the population mean). Now if the population standard deviation is 100, then the standard deviation for your distribution of sample means would be:

$$\sigma_{\bar{x}} = \frac{100}{\sqrt{500}} \approx 4.5$$

1. You may be used to viewing $\bar{x}$ as a statistic. Now it's a variable itself. Write a short paragraph explaining how you're viewing $\bar{x}$ differently now.

In a normal distribution, about 95% of the variable values will lie within two standard deviations of the distribution mean. Thus in your example, you expect that 95% of the means of your samples should be within $2(4.5) = 9$ points of $\mu = 474$. To say that $\bar{x}$ lies within 9 points of μ is the same as saying that μ lies within 9 points of $\bar{x}$. Thus, for 95% of the sample means, μ will be between $\bar{x}-9$ and $\bar{x}+9$. The interval of numbers between $\bar{x} \pm 9$ is called a 95% confidence interval for μ.

2. A random sample of 500 students from the population of all 1991 SAT-M test takers has a mean score of 480. Compute, by hand, the 95% confidence interval for μ based on this sample. _____

Using the HP 49G to calculate confidence intervals

Turn on the calculator and press (→) STAT. Select the Conf. interval option. In that choose box, select Z-INT: 1 μ, which will take you to an input screen. To recompute problem 2, use these values:

x̄: 420	n: 500
σ: 100	C: 0.95

Press OK. When the computation is finished, you will see a screen that contains two *z*-scores that correspond to the endpoints of the interval that contains 95% of the area under the standard normal curve. These are sometimes called the critical *z*-scores. You will also see numbers labeled as μ Min and μ Max. These correspond to the endpoints of the confidence interval. Now press PLOT. This shows the standard normal curve with the critical *z*-scores identified. Below the curve is a scale showing the sample mean lined up with the standardized mean of 0, and μ min and μ max lined up with the critical *z*-scores. Press TEXT to return to the previous display or press OK to return to the stack.

3. Did the calculator return results identical to the results of your hand calculations in problem **2**? Why or why not?

In practice, the population mean μ, is usually not known. Statisticians use confidence intervals based upon a sample mean to estimate the population mean.

4. Suppose you're interested in the 1991 SAT-M scores for the population of students from California. A random sample of 300 California students that took the SAT-M is examined and a sample mean of 471 is computed. Assume that the population standard deviation is still 100. What is the 95% confidence interval for μ, the mean of the population of California SAT-M test takers in 1991, based on this sample?

5. What is the 99% confidence interval for μ in problem 4?

6. What is the 90% confidence interval for μ in problem 4?

7. How does the confidence interval size affect the confidence level? Why?

A caution about confidence intervals: A 95% confidence interval for μ does not say that the probability is 0.95 that μ falls within the interval. It merely says that the interval as computed gives correct results in 95% of all the samples. No randomness remains after a particular sample is selected; the population mean either falls within the confidence interval computed on that sample or it doesn't. (Note, too, that samples must be selected randomly from the population. The method of computing confidence intervals relies on the central limit theorem, which applies only to random samples from a population.)

(continued on page 14)

Confidence intervals in practice

So far, the method of computing confidence intervals relies on knowing the population standard deviation, σ, but this is rarely true in practice. Fortunately, there is a way around this limitation.

In the method outlined above, deciding on a 95% confidence level determined two z-scores between which lay 95% of the area under the standardized normal curve (namely $z \approx \pm 1.96$). This is graphically illustrated by the HP 49G.

Knowing $\bar{x}$ (the sample mean), n (the sample size), and σ (the population standard deviation), you can algebraically find the value of μ for each z-score, using this relationship: $z = \dfrac{\bar{x} - \mu}{\sigma/\sqrt{n}}$

These calculated values of μ could give the confidence interval for the population mean, although it's rare that you need to estimate the population mean. However, you do know σ, the population standard deviation, and it seems natural to substitute s, the sample standard deviation, for σ in the above formula. Doing so does not give a z-score, however. It gives a new statistic called a t-score:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

Unlike the z statistic, the t statistic does not have a normal distribution. It has a distribution called the t distribution. Furthermore, there is a different t distribution for every sample size n. Statisticians classify t distributions in terms of *degrees of freedom*. The number of degrees of freedom of a t distribution is equal to $n - 1$.

For example, suppose you want to use the mean and standard deviation from a sample of 500 to compute a 95% confidence interval for the population mean. You must find the two t-scores between which lies 95% of the area under the curve of the t distribution with 499 degrees of freedom. Fortunately, the HP 49G does most of this for you....

Revisiting problem **4**: Suppose a random sample of 300 California SAT-M scores is examined and a sample mean of 471 is computed. Instead of assuming a population standard deviation of 100, you now compute the standard deviation of the sample to be 92. What is the 95% confidence interval for μ, the mean of the population of California SAT-M test takers in 1991, based on this sample?

Press [→][STAT], select the `Conf. interval` option, and choose `T-INT: 1 μ`, which will take you to an input screen. Enter these field values:

`x̄: 471` `sx: 92` `n: 300` `C: 0.95`

Press [OK]. When the computation is finished, you will see a screen that contains two *t*-scores that correspond to the endpoints of the interval that contains 95% of the area under the curve of the *t* distribution with 299 degrees of freedom. These are often called the critical *t*-scores. You will also see numbers labeled as μ Min and μ Max. These correspond to the endpoints of the confidence interval.

Now press [PLOT]. This shows the appropriate *t* distribution curve with the critical *t*-scores identified. Below the curve is a scale showing the sample mean lined up with the *t* distribution mean of 0, and μ min and μ max lined up with the critical *t*-scores. Notice the *t* distribution looks very similar to the normal distribution. In fact, the *t* distribution resembles the normal distribution more closely as the number of degrees of freedom increases. Press [TEST] to return to the previous display or press [OK] to return to the stack.

The speeds of 25 cars traveling past a point on a country road are measured on a sunny day. These speeds (in MPH) are given here:

56 49 44 61 67 43 51 53 57 60 59 47 55
58 67 43 66 62 64 51 61 61 48 56 62

8. Find the 95% confidence interval for μ based on this sample.

9. Find the 99% confidence interval for μ based on this sample.

10. Find the 90% confidence interval for μ based on this sample.

11. Does the confidence level have the same general effect on the size of the confidence interval as in question 7?

12. Are these estimated values for μ good indications of the mean speed of all of the cars that have ever passed this point in the road? Explain.

Michael Grasse teaches AP Calculus and is the Computer Co-coordinator at Elk Grove High School in Elk Grove Village, IL. A 1993 grant awardee in the Calculus Connections Project, he has taught HP graphing calculator workshops across the U.S. and in Singapore. Michael enjoys camping, photography and beer making. He lives with his wife, Nicolle, and dog, Scout, in Des Plaines, IL.

Solutions to selected questions

1. *You're now analyzing a set of data representing many sample means.*

2. *(471, 489)*

3. *The area under the normal curve in the range (μ−2σ,μ+2σ) is only approximately 95%. Look at the critical z-scores returned by the calculator. Round-off error in computing σx in question 2 also contributes to difference in the answers.*

4. *To 3 places: (459.684, 482.316)*

5. *To 3 places: (456.128, 485.872)*

6. *To 3 places: (461.503, 480.497)*

Note: The sample mean and standard deviation must be computed before the confidence intervals can be computed.

8. *To 3 places: (52.980, 59.100)*

9. *To 3 places: (51.893, 60.187)*

10. *To 3 places: (53.503, 58.577)*

12. *No, this sample is biased toward good road conditions.*

Extensions

Ask students to devise a survey question to ask students in the school upon which a mean confidence interval could be computed. Then determine a random sample, conduct the survey, collect data, and analyze the results.

About the HP 49G

Frequently Asked Questions

How do I adjust the contrast on my display?

Hold down the ON key and tap either the + key (to darken the contrast) or the − key (to lighten the contrast).

How do I change the number of decimal places displayed?

Press MODE and change the `Number Format` field to `Fixed`, then choose from `0` to `11` decimal places and press ENTER. The default mode is standard (`Std`), where you see only the number of decimal places necessary to display the result.

What does ▸ or ⌟ mean at the end of a display line?

It means the displayed object is too long to display on one line.

Why do some numbers have decimal points, while others don't?

On the HP 49G, there are two distinct types of numbers: real and integer. Only real numbers are displayed with a decimal point. Integers offer a larger range than real numbers. For example, you can calculate 100!, a 158-digit integer.

Why won't `SIN(π)` always give a result of exactly zero?

First, the HP 49G must be in radians mode; after all, $\sin(3.1415°)$ isn't zero. If the `RAD` annunciator does not appear at the top left of the display, press MODE and change the `Angle Measure` to `Radians`. Next, press [redacted] and clear (that is, un-"check") the `Numeric` and `Approx` fields. Otherwise, the HP 49G will assume you want a numeric calculation, which, for an irrational number like `π`, will always be an approximation if represented in a finite number of decimal places.

Why doesn't changing the angle mode affect a vector's display?

Since a converted display could require non-integer values, changing the angle mode affects the display only of real-valued—not integer-valued—vectors.

How do I convert units?

In Algebraic mode, use `CONVERT` (via ↱ UNITS, `Tools..`) with two arguments: the current value (with its unit), then a `1` with the target unit. (To avoid implying multiplication, you must type the underscore, _, between value and unit.) For example, to convert 100 meters to yards, use `CONVERT(100_m,1_yd)`.

In RPN mode, the syntax is `100_m 1_yd CONVERT`. (Or, if flag -117 is set, you can use a menu shortcut: `100_m` ↰ [redacted].)

How do the function keys, F1-F6, work in RPN mode?

In RPN mode, to access the top row of keyboard functions (Y=, WIN, etc.), you must **hold down** the ↰ key. For example, to go to the `TABLE SETUP` window, you must press ↰-**HOLD** TBLSET. This is to allow for menus with "shifted" shortcuts. For example, the VAR menu has shortcuts for store (↰) and recall (↱); and the UNITS menu has shortcuts for conversion (↰) and division (↱).

How do I make the HP 49G work like a HP 48?

First, set it to RPN mode (MODE +/− ENTER). Then specify choose boxes instead of menus, by setting flag -117 (`-117 SF`). (The HP 49G even supports the HP 48's menu system: You can get to any HP 48 menu by entering the appropriate menu number, then using the `MENU` command.)

How do I check how much free memory is left in my calculator?

[←] FILES shows the unused memory in each of the HP 49G's ports. Port 0 is the calculator's main memory (RAM). Port 1 is extended memory (like a RAM card in the HP 48). Port 2 is the FLASH ROM. FLASH memory will hold data even when no power is available—a good place to archive if you lack a connection to a PC.

What keyboard shortcuts does the HP 49G offer?

These shortcuts are available in Version 1.16 of the HP 49G ROM.

Navigation and environment aides:

- [←]-HOLD NXT: Last menu
- [→]-HOLD ENTER: Toggle Exact/Approximate mode
- [→] [▶]: Xmodem Server
- [→]-HOLD [▶]: Kermit Server
- [←]-HOLD VAR: HOME
- [←]-HOLD ANS: Last Argument(s) or previous calculation
- [→]-HOLD 9: Time-Tools menu
- ON-C [⬅]-HOLD: Bypass library configuration routines. (Useful when downloaded software malfunctions or is incompatible.)

Typing aides:

- ALPHA [→]-HOLD O: ù
- ALPHA [→]-HOLD 2: ¡
- ALPHA [→]-HOLD 3: ¿
- ALPHA [→]-HOLD 6: ª
- [→]-HOLD ': ;
- [→]-HOLD !: ' ' (RPN mode only)

Other shortcuts not requiring you to hold down a key:

- ENTER: DUP
- [⬅]: DROP
- [◀]: Display PICTURE environment
- [▶]: SWAP (RPN mode only)
- [▲]: HIST or interactive stack (RPN mode)
- [▼]: Edit object with context sensitive editor
- [←] [▼]: Invoke command line editor on object
- [→] [▼]: List menus in display

I downloaded some software and now my calculator has locked up. What can I do?

Try bypassing the startup routine by pressing ON-C and holding down the [⬅] key while the calculator boots. If that doesn't do it, use a paper clip in the reset hole on the back of the machine, then repeat the above ON-C procedure.

I've lost/broken a battery door, port cover or rubber foot.

To replace it, call your nearest Calculator Support team. The information is on the inside back cover of the HP 49G Owner's Handbook.

Where can I get replacement batteries for my calculator?

The HP 49G uses three standard size AAA batteries, available in most drug stores, camera stores, or grocery stores. Use all the same brand and type. Avoid Nicad batteries, which have low capacity and short low battery warning times.

Delicious Problem Solving

More Persons = More Pizzas

Adapted from HP's "Keys to the Calculator"

Pizza is always welcome for dinner. But what if guests drop in unexpectedly? How do you expand a recipe of ingredients from one pizza to, say, 4? Or 8?

Use the automatic constant on the HP 6S (see *Keys to the Calculator*) to compute the amount of each ingredient and fill in this table:

Number of Pizzas	1	4	8	16	24
Cups of pizza sauce	3/4				
Cups of grated cheese	4/5				
Teaspoons of oregano	1/2				
Cups of mushrooms	1/3				
Slices of tomato	5				
Cups of sliced olives	1/4				

How could you use proportions to calculate these amounts?

This is the sort of calculation where the automatic constant feature of the HP 6S comes in very handy.

For example, the recipe calls for 4/5 of a cup of grated cheese for each pizza, but there are several ways to use that information.

1. Use the [×], [÷] and [=] keys (and the number keys, too, of course) to find how many cups of cheese you need for 4 pizzas.
2. Now use [A B/C], [+] and [=] (and the number keys) to do the same calculation.
3. Use [+] and [=] to do the cheese calculation for 8 pizzas.
4. What keystrokes did you use in questions **2** and **3**? How many times did you press [=] to the get the answer in each case?
5. How does this compare to the information given in the problem?
6. What pattern do you see?

Food for Thought

What if you don't start by knowing the number of pizzas to make? All you know is the number of persons you need to feed (say, 18)—and you know that 2 pizzas will feed 5 persons? How would you figure out the recipe from that?

This article was excerpted in part from "Keys to the Calculator: NCTM-based Middle School Activities for the HP 6S," a book available from HP through the HP Educator Program at The Math Learning Center. See page 5 for full details on how to contact MLC to acquire this book.

About the HP 6S

Frequently Asked Questions

How do I make the shifted functions work on the HP 6S?

Press the colored key, [INV], prior to pressing the desired key. (Notice that the shifted functions of the keys are labelled in the same color as [INV].)

What's that letter E in the display —and how do I get rid of it?

The E indicates that an error has occurred. To remove it, press [C/CE].

What's that letter M in the display , and how do I get rid of it?

The M indicates that the memory register contains a non-zero value. To remove the M, press [0][X→M].

How do I power off the HP 6S Solar model?

The HP 6S Solar model is powered by both a battery and a solar cell. When the light is low, the battery powers the unit. There is no way to turn the calculator off, but the battery should last approximately 3 years in constant use (total darkness).

Some of the keys appear not to be working. What's wrong?

By design, in certain modes such as BIN, OCT and HEX, not all keys work. If you press [MODE][DEC], then all keys should function correctly.

Why do I get an error whenever I take the square root of a negative number?

The square root of a negative number is a non-real number. The HP 6S works only with real numbers.

Where can I find a new manual for the HP 6S?

Visit **http://www.hp.com/calculators**.

Where can I get more help using the HP 6S with my students?

Contact the **HP Educator Program** (see "How to Contact HP" in this issue).

Old and New Dimensions

A Quick Lesson on Units on the HP 48G Series

By Chris Coffin and Tom Dick

An inappropriate mix of physical units in your calculations is all too easy to do—but it can have disastrous results, as a recent Mars mission failure demonstrated. The HP 48GX can use units in calculations to help you catch such errors, but only if you use it correctly—and then make sure the results are expressed only in the units you wanted. To use the calculator's units tools, press [→][UNITS]. Then:

To **attach** a unit object to a real number (or to another unit) object, just press the desired unit's menu key. This *multiplies* the given object by the selected unit. For example, to form `2.54_cm`, you'd press [2][.][5][4] [→][UNITS] LENG CM.

To **attach the inverse** of a unit object to a real number (or to another unit) object, just press [→], then the desired unit's menu key. This *divides* the given object by the selected unit. For example, to form `1.8_°R/K`, you would press [1][.][8] [→][UNITS] [NXT] TEMP °R [→] K.

To **convert** a unit object to another (equivalent) unit object, just press [←], then the desired unit's menu key.* For example, to express the distance of a marathon, `26.21875_mi`, in kilometers, press [2][6][.][2][1][8][7][5] [→][UNITS] LENG [NXT] KM, then [←] KM. (Result: `42.194988_km`)

Addition and **subtraction** of units require like dimensions. The units of the result, will match those of the *second argument*. For example, to add 2 feet and 3 inches, press [2] [→][UNITS] LENG FT [3] IN [+] (result: `27_in`). You will instead get `2.25_ft` if you reverse the order of the arguments (3 inches, then 2 feet).**

Multiplication and **division** of units don't require like dimensions; you can mix them. For example, to multiply 2 feet by 3 pounds (force), press [2] [→][UNITS] LENG FT [3] [→][UNITS] [NXT] FORCE LBF [×] (result: `6_ft*lbf`).

To **convert** a unit object to its equivalent SI base units, use `UBASE`. For example, continuing the previous example, to convert `6_ft*lbf` to SI base units, press [←][UNITS] UBASE. (Result: `8.13490768999_kg*m^2/s^2`)

**This method works fine if you're calculating at the keyboard, where you have access to the menu key shortcuts. If you're needing to do such a conversion within a program, put the current unit object onto the stack, then the desired unit (any value), then execute the* `CONVERT` *command.*

***Notice, therefore, that this offers you yet a third way to convert a unit A to an equivalent unit B: Just add zero of unit B.*

Building Your Own Machine

Custom Key Assignments on the HP 48G Series

By Chris Coffin and Tom Dick

With a programmable calculator as powerful as the HP 48G Series, you can customize it to almost any extent: programs, modes, menus, directories. You can even redefine the physical keyboard, so that keys evaluate the objects of your choice, rather than the "factory standard" functions and operations.

When the HP 48G/GX is in USER mode (↶USER is a toggle key much like α), The keyboard keys evaluate a list of objects that are assigned to various keys via ***keycodes***—simple real numbers of the form *RowCol.Shift*. That is, the tens digit of a keycode value indicates the row number of the desired key; the ones digit gives the column number; and the tenths digit tells the shift mode. (See the table at right.) For example, the keycode for the unshifted 8 key is `63.0` or `63.1`. And the keycode for the `k` key (α↶K) is `25.5`.

Keycode (tenths digit)		Shift mode
0 or 1	=	unshifted
2	=	↶-shifted
3	=	↷-shifted
4	=	α-shifted
5	=	α↶-shifted
6	=	α↷-shifted

To assign object(s) to selected key(s), just enter the object-keycode pairs into a list on the stack: `{` obj_A $keycode_A$ obj_B $keycode_B$ ... `}`, then use `STOKEYS`.

To un-assign certain keys (i.e. revert them to their standard functions), enter a list of the desired keycodes and use `DELKEYS`. Or, to quickly un-assign all keys, use `0 DELKEYS`.

Sometimes you may want to assign certain keys, then disable the rest (i.e. assign them to "nothing"). To do this, use `'S' DELKEYS`. To then re-enable some keys to their standard functions, enter a list, `{ 'SKEY'` $keycode_A$ `'SKEY'` $keycode_B$ ... `}`, then `STOKEYS`. (Or, to assign certain keys while re-enabling all others, put `S` as the first object in your assignment list, then use `STOKEYS` as usual.) To re-enable all keys, use `0 DELKEYS`.

Note that you can view the entire current key assignments list at any time by using `RCLKEYS`.

This article was excerpted in part from "The HP 48G/GX Pocket Guide," a book co-authored by Chris Coffin and Tom Dick, published by Grapevine Publications (800-338-4331 or www.read-gpi.com).

Chris Coffin (chris@read-gpi.com) is the author or co-author of some 30 instruction books. He is CEO of Grapevine Publications, a Corvallis, Oregon, publisher of plain-English books on technology since 1983.

Tom Dick (tpdick@math.orst.edu) is a professor in the Department of Mathematics at Oregon State University in Corvallis, Oregon.

About the HP 48G

Frequently Asked Questions

Why does my HP 48 flash when I turn it on, or pause momentarily during a calculation?

This is normal. The pauses are to "tidy up" memory (needed more often as more memory is used).

What is the meaning of the ▷ annunciator?

It signals either a low battery or past-due alarm. To find out which, turn the machine off, then on.

Is the calculator malfunctioning or am I doing something wrong?

See page A-9 of your User's Guide, "Testing Calculator Operation."

How much free memory does my calculator currently have?

To find out, press ↰ MEMORY MEM.

How do I change the display format or decimal places?

Use ↱ MODES or ↰ MODES FMT. See page 4-2 of your User's Guide.

What's that E in my number?

This is scientific notation. For example, 6.02E23 = 6.02×10^{23}.

How do I get a new battery door, port cover, or rubber foot?

If you're in the U.S. or Canada, call Hewlett-Packard at 970-392-1001. (For other locations see "How to Contact HP" in this issue.)

What kind of replacement batteries should I get for my machine?

Use three size AAA, all of the same brand. NiCad batteries are not recommended, due to their low capacity and short warning time. See also page A-5 of your User's Guide.

How do I adjust the display to make it easier to read?

While holding the ON key down, press + or − repeatedly.

Why is my calculator "locking" up or behaving strangely?

See "Special Memory Operations" on page 5-16 of the User's Guide.

Why can't I find my variable(s)?

You're now in a different directory than where you stored the variable(s).

Why am I getting wrong results with trig functions?

Check the angle mode. If you see the annunciator RAD or GRAD, the machine isn't using degrees. Use ←RAD or the →MODES menu to adjust accordingly.

Why don't I get 0 when I take the sine of pi?

If you get 'SIN(π)', the calculator is in Symbolic Results mode (i.e. Flag -3 is clear) but not in RADians mode. Set RADians mode (via ←RAD), then use either ←→NUM or EVAL. EVAL will return the trig identity, 0, if Flag -2 (Symbolic Constants) is also clear. Otherwise, EVAL behaves like ←→NUM, which never returns 0, because it does its calculation on the 12-digit approximation of π, 3.14159265359. (No machine uses a numerically exact value of π; it has an infinite number of digits.) And the sine of 3.14159265359 radians is simply not zero. For similar reasons, pressing 2 √x ←x² on the HP 48 doesn't return 2.

Why do I get an Undefined Name error when integrating or differentiating?

The machine is in Numeric Results mode (Flag -3 is set) but is encountering symbolic arguments. Either change the flag or numerically define the arguments.

Why does the calculator give me complex numbers when I evaluate expressions such as '(-1)^(2/3)'?

The machine gives a complex principal solution for expressions with fractional exponents. To get a real-valued result to the expression, you need to use 'XROOT(3,(-1)^2)' (or the keyboard equivalent to it: 1 +/− ←x² 3 →$\sqrt[x]{y}$).

Why am I getting error messages such as Too Few Arguments or Bad Argument Type?

The command you are attempting needs more or different-type arguments than what it currently finds on the stack. (See also Appendix B in your User's Guide.)

How do I turn off the HALT annunciator?

Use KILL (PRG NXT RUN KILL).

Why does my machine seem to gradually slow down?

It may need to clean up fragmented sections of memory. To do a cleanup, while holding down ON, press and release C. (This clears both the stack and PICT.)

Why am I getting mixed units in the Equation Library Solver even after I have specified ENG or SI?

The Solver creates only variables not already present in the current directory; the already-present variables may have unintended units. For unit consistency, first select your desired equation category in the Equation Library, press UNITS NXT PURGE, then select your units.

Educator Resources

*The easy way to integrate Hewlett-Packard calculators into the learning process? Try them for yourself! That's what the HP Educator Program is all about. Through HP's partnership with The Math Learning Center (**MLC**—see the contact information on the next page), you have a wide variety of ways to learn about and get HP products into your classroom.*

Evaluating an HP Calculator

To evaluate any particular HP calculator model for use in your classroom, just contact **MLC** and they'll send you a simple request form. The form asks which classes (subjects and levels) you now teach, and which calculator(s), if any, you now use. Then you just indicate which model HP calculator you'd like to try, and for which classes. (Limit: One model at a time per educator.)

HP wants your comments and feedback, too. There's space on that same form to tell them what they could do better to support your teaching and what would encourage you to consider using an HP model in your classroom.

A simple call to **MLC** will get you started.

HP Calculator Loaner Sets For Your Whole Class

If you've made your evaluation—and liked what you saw—you can see how your students will fare, too. HP offers complete classroom loaner sets:

HP 6S: 30 HP 6S calculators, 1 HP 6S manual, shipping case.

HP 30S: 30 HP 30S calculators, 1 HP 30S overhead calculator, 1 HP 30S manual, shipping case.

HP 38G or 39G: 30 HP 38G or 39G calculators, 1 overhead display panel (& cable), 1 Connectivity Pack, 1 HP 38G or 39G manual, shipping case.

HP 48G+: 29 HP 48G+ calculators, 1 HP 48GX calculator, 1 overhead display panel (& cable), 1 Connectivity Pack, 1 HP 48G+ manual set, shipping case.

HP 49G: 30 HP 49G calculators, 1 overhead display panel (& cable), 1 Connectivity Pack, 1 HP 49G manual set, shipping case.

The sets are available for loan for two to four weeks. (Longer periods may be granted on a case-by-case basis, depending on availability.) Again, contact **MLC** for full details.

Free Classroom Materials

Then, to help you successfully integrate HP calculators into your classroom, Hewlett-Packard offers a wide assortment of materials and aids:

- Classroom posters for HP 6S, HP 30S, HP 38G, HP 39G, HP 48G series, or HP 49G.
- Overhead transparencies of all HP calculator keyboards.
- Training guides, examples and lesson ideas for the HP 6S, HP 30S, HP 38G, HP 39G, HP 48G series, and HP 49G.
- Additional copies of any issue of this newsletter—or a free subscription.

To request any of these materials, contact **MLC**.

Training Workshops

HP is committed to helping you get the most out of HP graphic calculators through its ongoing training program. For an up-to-date list of scheduled workshops on HP graphic calculators, contact **MLC** by phone, mail, e-mail or fax.

Or, if the already-scheduled workshops don't fit into your calendar, schedule your own! **MLC** has a list of instructors who are available to conduct workshops on HP graphic calculators—and they also will help you publicize it. (Just send information on your workshop to **MLC** after you have finalized the schedule.)

Or what if the full teacher-training workshop format doesn't quite fit? What if you want to include students or other staff? No problem. MLC and HP can arrange custom presentations, tailored to your exact audience.

Online Help

Don't forget HP's web site: **www.hp.com/calculators**. And there is additional help for educators via e-mail at **hphelp@bbs.mlc.pdx.edu**.

The Math Learning Center (MLC)
Hewlett-Packard Educator Program, P.O. Box 3226, Salem, OR 97302-0226
Tel: 800.750.8130 (8-5 PT, M-F, U.S./Canada)
Fax: 503.370.7961, E-mail: hp@bbs.mlc.pdx.edu

More Resources:
A Smart Data Collector

Heating, cooling, time, motion, friction, magnetic fields, light, sound, pH, humidity...

The everyday physical world is filled with learning opportunities in applied math, science and engineering. The Portable DataLab (Firmware Systems, Inc.) seizes these opportunities, taking full advantage of the computational power of the HP 49G, HP 48G Series, HP 39G and HP 38G calculators and most common personal computers.

Now students can collect and analyze data in the classroom, the field, and many other research environments, with calculator transfer rates of up to 9.6K baud. For computer-based data logging applications, the DataLab's hardware design and software also work with the PC and Macintosh platforms, at communication speeds up to 56K baud.

The DataLab Companion software makes everything simple. It optimizes each calculator's commonly used keys, analysis functions and memory, and shows real-time displays and graphs. It lets you store and retrieve experimental setups and easily specify ports and calibrate probes.

With a capacity of 32,000 data points, high-resolution triggering, and CMOS-compatible digital ports, the DataLab opens up your options for accurate, flexible, multi-channel control and testing—all in a simple and low-cost handheld package.

Portable DataLab Specifications

- External ports: 3 analog, 1 digital input, 1 digital output (digital I/O has 4 lines + clock), 1 ultrasonic motion detector
- COM port with standard 9-pin serial connector and transfer speeds up to 56K baud
- CMOS-compatible digital I/O ports • 12-bit A/D converter • Analog channels can be triggered at any level
- Collection rates up to 20,000 data points per second • Simultaneous sampling on all channels
- Compatible with many commonly available probes • Probe auto-identification capability
- External temperature probe included • Built-in microphone and light sensor
- Powered internally by 4 AA batteries • External power via AC adapter or 12-volt DC
- Operating environment: 0° – 45° C; maximum humidity 90% at 40° C
- Durable plastic case: 21.0 x 9.0 x 3.5 cm • Weight (w/batteries): 326 g
- Software for HP 38G, HP 39G, HP 48G Series, HP 49G, PC and Macintosh
- Classroom activity source book included for math, physics and chemistry
- One-year limited warranty

More Resources: Books and Software

The books listed here address the use of HP Graphic calculators. (HP does not represent or endorse them.)

For these and other books, see your local bookseller or visit amazon.com online (and search with keywords such as "HP 48G," "HP 39G" or "HP 38G").

Public-domain software is also available via links from HP's web site at www.hp.com/calculators.

Algebra & Pre-Calculus on the HP 48G/GX
Dan Coffin; Grapevine Publications; ISBN 0-931011-43-4

Calculator Enhancement for Differential Equations
T.G. Proctor; Harcourt Brace Jovanovich; ISBN 0-155056-73-5

Calculator Enhancement for Linear Algebra
D.R. LaTorre; Harcourt Brace Jovanovich; ISBN 0-155056-74-3

Calculator Enhancement for Multivariable Calculus
J.A. Reneke; Harcourt Brace Jovanovich; ISBN 0-155056-78-1

Calculator Enhancement for Single-Variable Calculus
James Nicholson; Harcourt Brace Jovanovich; ISBN 0-155056-76-X

Calculus Activities for Graphic Calculators
Dennis Pence; PWS Publishing Co.; ISBN 0-534924-31-X

Calculus Concepts: Graphing Calculator Instruction Guide
Iris B. Fetta; DC Heath and Co.; ISBN 0-669398-69-1

Calculus Concepts: An Informal Approach to the Mathematics of Change
D.R. LaTorre, John W. Kenelly, Iris B. Fetta, Cynthia R. Harris, Laurel L. Carpenter; DC Heath and Co.; ISBN 0-669398-65-9

Calculus Investigations with the HP 48G/GX
D.R. LaTorre; Charles River Media, Inc.; ISBN 1-886801-18-5

Calculus of a Single Variable
Thomas P. Dick, Charles M. Patton; PWS Publ. Co.; ISBN 0-534939-36-8

Differential Equations using the HP 48G/GX
T.G. Proctor; Charles River Media, Inc.; ISBN 1-886801-19-3

An Easy Course in Using and Programming the HP 48G/GX
Chris Coffin; Grapevine Publications, Inc.; ISBN 0-931011-41-8

Experiments in Computational Matrix Algebra
David Hill; Random House/Birkhauser; ISBN 0-394356-78-0

Exploring Calculus with a Graphing Calculator
Charlene E. Beckman, Ted Sundstrom;
Addison-Wesley Publishing Company; ISBN 0-201555-74-3

Graphing Calculator Laboratory Manual for Calculus
Charlene E. Beckman, Ted Sundstrom;
Addison-Wesley Publishing Company; ISBN 0-201549-71-8

HP 48G/GX Investigations in Mathematics
D.R. LaTorre, Donald Krieder, T.G. Proctor; Charles River Media, Inc.; ISBN 1-886801-23-1

Linear Algebra Investigations with the HP 48G/GX
D.R. LaTorre; Charles River Media, Inc.; ISBN 1-886801-20-7

Mastering the HP 38G Graphics Calculator – A Guide for Students and Teachers
Colin Croft; Applications in Mathematics; ISBN 0-958691-72-X

Technology in Calculus
Thomas P. Dick, Charles M. Patton; PWS Publishing Co.; ISBN 0-534930-81-6

More Resources: Redemption Program

What Can You Get?

When you and your students buy Hewlett-Packard calculators, you're on your way to earning free calculators and accessories through HP's Calculator Redemption Program, open to all educators throughout the U.S and Canada. This program is based on a simple point system. When your school or students buy any HP calculator or calculator accessory, you'll earn points that you can redeem toward free calculator products and accessories.

For 25 Points	For 50 Points	For 75 Points	For 100 Points	For 125 Points
HP 6S *or* **HP 6S Solar** *or* **HP 30S**	**HP 10B** *or* **HP 20S** *or* **HP F1897A*** (PC Connect. Pack) *or* **HP F1898A*** (Mac Connect. Pack)	**HP 12C** *or* **HP 32SII** *or* **HP 39G**	**HP 17BII** *or* **HP 48G** *or* **HP 48G+** *or* **HP 82240B*** (Infrared Printer)	**HP 19BII** *or* **HP 48GX** *or* **HP 49G** *or* **HP F1212A*** (Overhead Display) *or* **Portable DataLab*** (by Firmware Systems)

You can apply your redemption points flexibly—in whatever way works best for your program. For example, if you earn 100 points, you could apply it all to a single redemption from the 100-point column or choose multiple or combination redemptions from the lesser columns. (Note, however, that odd point overages are not retained: If you redeem 104 points, the extra 4 points are forfeited.)

How Do You Earn Points?

You earn points through purchases of HP calculators or accessories,* as follows:

Calculator or Accessory Purchased	Points Earned/Unit
HP 6S *or* **HP 6S Solar**	1
HP 10B, HP 20S, HP 30S *or* **HP Connect. Pack (PC** *or* **Mac)**	2
HP 12C, HP 32SII *or* **HP 39G**	3
HP 17BII, HP 48G, HP 48G+ *or* **HP 82240B Infrared Printer**	4
HP 19BII, HP 48GX, HP 49G *or* **HP F1212A Overhead Displ.**	5

**The HP F1897A PC Connectivity Pack and HP F1898A Macintosh Connectivity Pack can be used with the HP 38G, HP 39G, HP 48G Series and HP 49G. HP F1897A works with Windows versions 95, 98, 2000 and NT. HP F1898A is System 8-compatible and requires a serial port. The HP Infrared Printer works with the HP 17BII, HP 19BII, HP 38G, HP 39G and HP 48G Series. The HP Overhead Display Unit can be used with the HP 38G, HP 39G, HP 48GX and the HP 49G. The Firmware Portable DataLab can be used with the HP 38G, HP 39G, HP 48G Series and the HP 49G.*

Special Limited-Time Offer:

Double Bonus Points

For a limited time, HP will ***double*** the normal point values (shown here) on purchases of the HP 6S, HP 30S and HP 39G calculators, if the points are redeemed by October 31, 2000. With double points, each HP 6S purchase thus earns 2 points; each HP 30S purchase 4 points; and each HP 39G purchase 6 points.

If you are a primary or secondary educator, just send the proof-of-purchase (UPC) codes from the ends of the boxes, along with a letter on your school stationery detailing the product(s) you want to receive. (Your position as an educator will be verified prior to fulfillment.)

If you are a college or university educator, just send a letter on your school's stationery that includes these three items:

What Documentation Do You Need?

1. A statement that HP calculators are required or strongly recommended for your class (please indicate models);
2. A description of the classes for which the HP calculator is required or recommended;
3. An estimate of the number of students purchasing HP calculators per term or semester.

(Only one request per department is eligible for each term or semester. Your position as an educator will be verified prior to fulfillment.)

Send your request and documentation to:

The Math Learning Center
Hewlett-Packard Educator Program
P.O. Box 3226
Salem, OR 97302-0226

Note that Hewlett-Packard Company reserves the right to change this program or discontinue it at any time and without notice. If you have any questions about the program, feel free to contact The Math Learning Center:

Where Do You Apply?

Call: 1-800-750-8130 (8-5 PT, M-F, U.S./Canada)
E-mail: hp@bbs.mlc.pdx.edu

In Detail: The HP 49G Graphic Calculator

The State of the Art

Count on HP to keep leading the way to new levels of easy-to-use-power in graphing calculators. From step-by-step solutions to textbook style equations, this is a learning and computing tool like no other. From its speed to its memory, and flexibility (even good looks!), it's a lot of calculator—a lot to like. It is truly the best of the best, with a level of capability and convenience that puts it in a class by itself—your class!

Technology For the New Millennium

The HP 49G offers something for everyone. It has the teaching tools for college-level math, science and engineering—even advanced high school math and physics—but it comes packed with plenty of advanced functions and sophistication for professionals, as well.

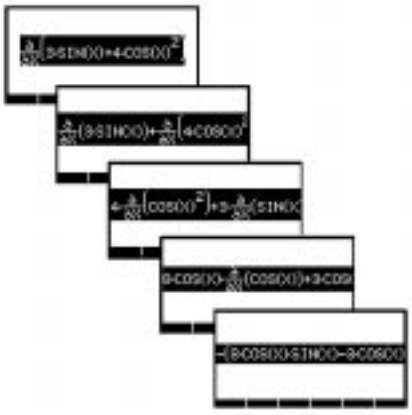
A large 1.5 MB of Memory (512KB RAM and 1 MB Flash ROM for data storage) takes full advantage of the largest, most comprehensive library of third party calculator software: programs, games and software applications. And 2MB of Flash ROM allows for future electronic software upgrades—no need to buy a new calculator to get a software upgrade or enhancement!

Futuristic Design, Too

If you get an HP 49G, you'll be using it—a lot. So why should you have to look at something dull and dreary? (Who says calculators have to look dull and dreary, anyway? Mathematics is serious, but it needn't be boring.) Smooth edges, soft curves and a sleek, sturdy design make the HP 49G ideal for either handheld or desktop use. It's cast in an appealing light metallic blue, with a matching translucent blue slide-on cover to protect the screen and keyboard.

But the glamour doesn't substitute for simple usability. The heart of a great design is still great functionality. So if you're weary of intimidating, confusing keyboard clutter, look at the HP 49G. Its user-friendly layout has large keys with soft edges and generous spacing to help minimize "fumble-finger" accidents. And the alpha letters appear on the key faces themselves, rather than above the keys, further helping to reduce keyboard clutter.

Let the HP 49G Help the Learning Process!



In homework or exams, the answer is only part of the solution, and now there's a calculator that can show you how it got there, too! (And the HP 49G's history display retains every result, so you can see and correct where you erred—or combine previous results to get fast new related solutions.) Use the CAS step-by-step mode for dynamic differentiation, integration and linear systems solving—true tutorial smarts. The HP 49G even prompts you for complex mode if it encounters complex equations or expressions.

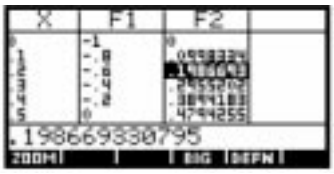
You see everything better and bigger too. Not only can you input and view expressions on the big 131 x 64-pixel display in "textbook" mode (i.e. as in a book or on the chalkboard), but you get all output steps and results that way, too, for easy viewing and understanding—in your choice of four font sizes and styles.

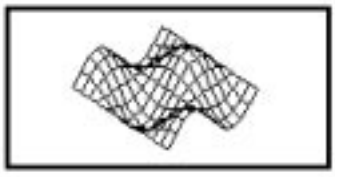
Got an example or solution you want to share with others? No problem: You can easily exchange programs, data and games with other HP 49G's and HP 48G Series models, via a unit-to-unit link serial cable. (But there's no infrared—which prevents "untimely communication" between students during exams!)

Power to the Pupil

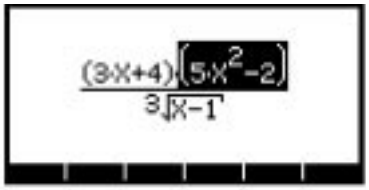
Behind the clear, clean displays and user-friendly features of the HP 49G lies a stunningly powerful math engine that can instantly cut your work. The HP 49G offers over 1000 functions and commands, all grouped in various menus, but the built-in catalogue serves them up to you, all under one convenient key.

Then there are the "power tools"—for graphing and solving and statistics.





After analyzing sample data, you can make and measure inferences about the population, with hypothesis tests and confidence intervals. You can input, view and edit sample data in a table format—like a computer spreadsheet or table—then plot the results. With some fifteen built-in plot types to choose from (and with zoom and trace options), visualization plays a leading role in the HP 49G's power to enhance your understanding of mathematical concepts.



Used to cut-and-paste on a computer? Enjoy it on the HP 49G, too, editing expressions, text, graphs and programs quickly and easily! And it's more than just a passive editor. You can isolate and evaluate sub-expressions too. The intelligent editor even inserts missing parentheses and prompts your inputs as you go!

(Please see page 39 for Bid Specifications for the HP 49G Graphic Calculator.)

In Detail: The HP 48G Graphic Calculator

The Platform of Choice

The HP 48G Series of graphic calculators represent the widest assortment of top-level machines—an impressive array of power, convenience, memory and functionality. Whether you want sophisticated graphics, input forms, dialog boxes, enhancements to plotting, 3-D graphics, or built-in equations—it's all here.

Take a good look. The HP 48G Series of calculators offers you and your students a full spectrum of choices in power, ease of use and expandability.

The HP 48G Graphic Calculator has 32 KB RAM built-in and includes all HP 48GX features except the plug-in option—an excellent choice when plug-in expandability is not a requirement.

The new HP 48G+ Advanced Graphic Calculator opens up new horizons. With a full 128 KB of RAM built-in—four times the memory of the HP 48G—think how many more equations, programs, notes and formulas your students can have at their fingertips!

The HP 48GX Graphic Expandable is, quite simply, the finest calculator for your education and career—period. With 128 KB of RAM built-in, plus the expandability of two plug-in ports for application cards or up to 1.25 MB of RAM, it's the most power you'll find in a calculator anywhere.

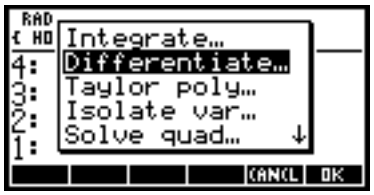
Power and Smarts

The power packed by the HP 48G Series is staggering. Graphics and calculus combine as in no other calculator. While you view the graph, the HP 48 finds roots, intersections, local extrema, derivatives, slopes, and areas under curves.

You also get hundreds of built-in equations for geometry, stress analysis, electrical engineering, fluid flow, heat transfer, and more—all with HP Solve that lets you play "What if..." by varying your known values and solving for the unknown values—even with multiple equations!

And if all this isn't already precisely what you need, the HP 48G Series also offers powerful, structured, object-based programming. Write quick, simple utility programs, and then combine them into sophisticated applications—with totally customized menus and key assignments to make their use even faster.

Built to Make Sense

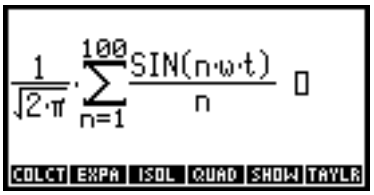


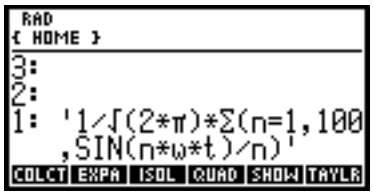
But is all this power only for the technically gifted? Not at all! The HP 48G Series is easy to use, even for beginners.

Look at the easy-to-use forms that speed up learning: each built-in application tool has an input form you just fill in.

With clear prompts and menus organized for easy access, you and your students get satisfying results quickly.

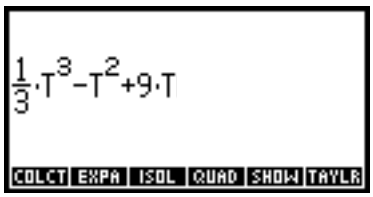
From unit management to matrices, the HP 48G Series is first-class in friendliness, too. For example, with the Equation Writer tool, you can key in an expression like this... ...instead of this....





And its symbolic math capabilities open new possibilities for your students. They can create expressions on the calculator,

then evaluate them symbolically....



Calculators that Expand with Your Horizons

You can add up to 1.125 MB of RAM to the HP 48GX—or customize it with plug-in application cards. It can grow with you—you'll never need another calculator! And even the HP 48G and HP 48G+ offer expandability via data transfer—and you don't even need cables with the built-in infrared I/O! Just send and receive files via the HP 48 infrared port—to another HP 48 or to the optional HP infrared printer. And for longer-term storage and exchange, the built-in serial port makes sharing just as easy: with the Connectivity Pack accessories, you can link your HP 48 to your Macintosh or DOS computer via RS-232 for file exchange, program storage, and program development.

(Please see page 40 for Bid Specifications for HP 48G Series graphic calculators.)

In Detail: The HP 39G Graphic Calculator

Easy, Powerful and Built for Math Class

The HP 39G has all the functionality and features of other graphic calculators, plus a lot more. Designed with the secondary school math classroom in mind, no other calculator makes learning and teaching math so exciting.

The HP 39G features E-lessons (also called ApLets), an exciting new set of built-in tools adapted from topics in textbooks, neatly packaged to help students learn faster and get more from classroom and homework sessions. E-lessons are the future of calculator-based instruction: powerful, flexible, easy. And the HP 39G can connect directly to a personal computer or an overhead display unit, so students can see your keystrokes or share their own work!

The HP 39G makes math make sense to students. Understanding comes more naturally when the calculator shows an expression in textbook format—just as it would appear in a book or on the board in class. And it can represent mathematical relationships numerically, graphically and/or symbolically: split-screen views let students compare two views at once, for a better conceptual grasp.

Easy Menus and Commands

The HP 39G uses standard algebraic notation for its operations—no need to learn new methods to do the same old calculations. And the HP 39G remembers your calculations for future use. Just move up the list and copy the information you want—it's point and shoot!

With easy-to-use menus, you get results fast. Pop-up menus offer commands with just a few keystrokes, and input forms offer easy screens to set up problems. Students just fill in the blanks.

Built-in Tools, Lots of Power

The HP 39G offers over 600 easy-to-find functions in clear, organized menus:

- HP Equation Solver • Factorization, expansion, substitution
- Function analysis—roots, extrema, slopes, areas and intersections
- Plotting—multiple types (function, parametric, polar, conic and statistical), with tracing and zooming
- Differentiation and Integration • Trig, exponential and log functions
- Linear systems, linear algebra and matrices (real and complex)
- Factorials & combinatorials • Lists & sequences • Complex numbers
- 1- and 2-variable summary and inferential statistics; regression models and plot types
- Programming to automate Views, E-lessons and calculations • Online help

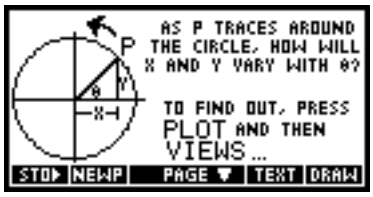
E-lessons Make Teaching Easier for You

E-lessons combine variables, pictures, graphs and custom-designed views into one complete package. With E-lessons, students can explore the problems without your guidance—and without fear of losing their work or the original lesson. They can save their work or start over if necessary. E-lessons are so natural to use that students will even begin to create their own to share with you and others.

Of course, the most popular E-lessons are built right into the HP 39G (such as the example below), with many others freely available for download from HP's web site. But it's also easy to create your own. Once you set up a problem for use in the classroom, you just save it. All of the configuration information is saved, along with any notes and sketches you've created, together in a package easily transferred to your students via wireless infrared. (You just point two calculators at each other and beam it across!) In very little time, everyone in class is working with the same information and problems—a complete lesson that *you* prepared.

Look at an example. An E-lesson (also called an ApLet) is stored in the ApLet Library.

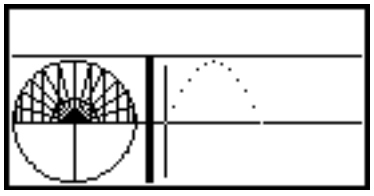
It can begin with a note....

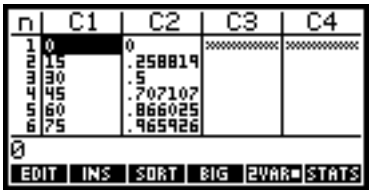


Students can then see a sketch of the problem...

and even customized views....

They can compare graphical and numeric views as they are generated.





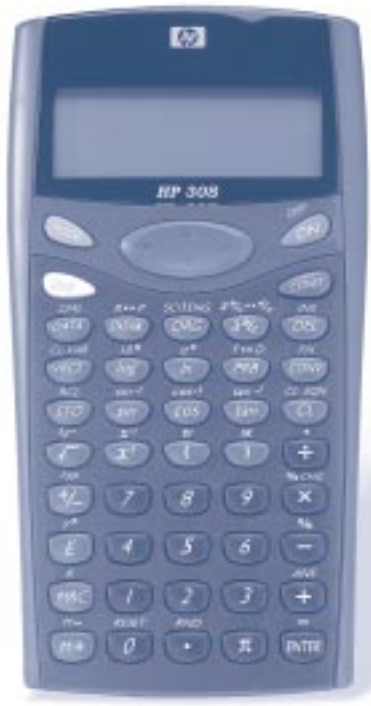
And if they goof, they just start over—the original ApLet isn't altered until saved.

(Please turn to page 40 for Bid Specifications for the HP 39G Graphic Calculator.)

In Detail: The HP 30S Scientific Calculator

What Students Like Students Use

The HP 30S has all the functionality and features of other scientific calculators, plus the distinctive HP quality and style for today's discerning student: large, generously spaced, soft-edged keys and interchangeable colored faceplates—two extra come with each calculator!



Easy on the Homework Easy on the Pocketbook Easy on the Eyes

The HP 30S combines value, power and convenience into one sleek, low-cost package. Students see and understand more in the large two-line display, with a convenient, editable command line history to save keystrokes in subsequent calculations.

To save even more keystrokes, there's also a smart constant mode that lets students instantly append any combination of numbers, variables, functions or operators to the command line.

Easy to Learn and Use, Too

Then there's the intuitive way it works: On the HP 30S, you just enter operators and data in the order you would use to solve the problem on paper. And what if they involve fractions or physical units? No problem! The HP 30S can convert fractions to decimals—and decimals to fractions—and handle a variety of units, both metric or imperial.

Lots of Tools for Class and Homework

Packed in a smart little case is a smart little calculator. With 250 built-in functions and 10 memory registers, and the ability to evaluate expressions involving multiple variables, the HP 30S gives students room to maneuver as they crunch numbers and solve problems. They get:

- Fractions and fraction/decimal conversions
- Percentage and percentage change
- Trigonometric functions
- Log and exponential functions
- Universal powers and roots
- Polar/rectangular conversions
- Univariate and bivariate statistics, with easy editing of the data sets

There's also an equation solver built into the HP 30S, so that students can quickly solve problems such as quadratic and linear simultaneous equations without tedious calculations.

Flexible for Math and Science

With all the above math features, plus unit conversions and physical constants, the HP 30S is well-suited for a wide variety of subjects in math and science:

- General Math
- Pre-Algebra
- Geometry
- Trigonometry
- Statistics
- Earth Sciences
- Biology
- Chemistry
- Physics

(Please turn to page 41 for Bid Specifications for the HP 30S Scientific Calculator.)

In Detail: The HP 6S Scientific Calculator

Affordable Essentials Kids Can See Themselves Using

*The HP 6S shouts "Future!" from the moment it slips out of its soft cover. With solar power, brilliant metallic finish, slim profile and large tactile keys, its looks almost outshine its calculating power—***almost**....

High Tech, High Touch

Sure, its "Wow" factor is high. Kids love to play with it, be seen with it, and check out its solar features. But beneath the gloss is serious power—a package with everything a middle-schooler needs to keep up and shine in math class.

It has all the basics, of course—powers, roots, logs, trig, pi—some 66 functions in all. But don't overlook the extra smarts that HP packed in its ultra-slim case:

- Fractions – help students make the connections to decimals and back.
- Angle and polar/rectangular conversions – a first look at vectors and the math of circular measure.
- Statistics – explore the basics of mean and standard deviation.
- Base conversions and arithmetic – for the budding programmers.

Into the Future With Confidence

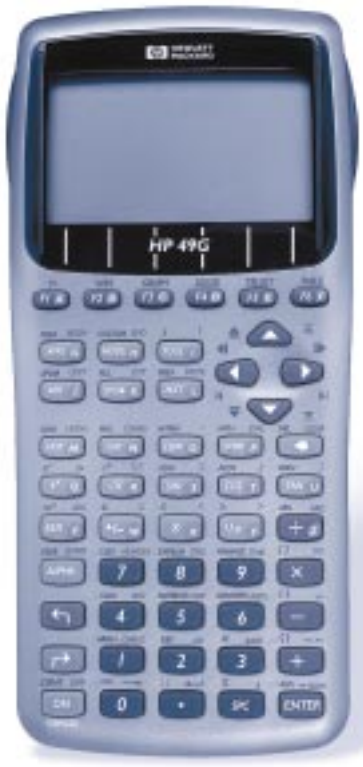
Here's a bright little device to bring out the best in active, inquisitive middle school learning. When kids are successful early, it's a feeling they remember—and aim for, again and again.

(Please turn to page 41 for Bid Specifications for the HP 6S Scientific Calculator.)

Bid Specifications: HP Graphic Calculators

HP 49G

- 1.5 MB RAM built in, with Flash ROM for electronic upgrades
- 131 x 64-dot display
- 12-digit numeric values with 3-digit exponents
- Dual operating modes: RPN or Algebraic, with results and history stacks
- Computer Algebra System allows enhanced and dynamic manipulation and solving
- Factorization, expansions and substitutions of expressions
- Select, Cut, Paste and Copy operations
- Step-by-step numeric and symbolic solutions
- "Textbook" format for equations and expressions in the Equation Writer and stack
- 4 font sizes built in, with capability to download other fonts
- Hierarchical storage structure for variables and subdirectories
- Customized menus
- Multiple plots on single graph; number of plots limited only by available memory
- Quadratic and polynomial root finders
- Symbolic and numeric integration and differentiation
- Differential equation solver
- Real, complex and symbolic matrices, with solutions of linear systems and matrix manipulation operations; sizes and numbers of matrices limited only by available memory
- Object-based user programming language; program sizes and numbers limited only by available memory
- Program structures include FOR, DO, IF, CASE, UNTIL, and WHILE
- 2D and 3D plotting—15 types, including function, conic, polar, parametric, truth, differential equation, bar, histogram and scatter plot
- Graphic controls include zoom, box Z, tracing, shading, spacing, axis tick marks, and scrolling
- Matrix operations include inverse, transpose, determinant, row operations, and row-to-column conversions
- Statistical capabilities include inferential testing, plus standard deviations, mean, linear regression, combinations, permutations and weighted means
- Lists and sequences
- Financial functions
- Date, time and alarm functions
- Physical constants and units libraries
- Keys can be assigned new functions or programs
- Serial-wired PC interface
- Overhead display and data collector accessories available
- Size: 8.9 × 18.7 × 2.8 cm (3.5 × 7.4 × 1.1 inches)
- Detachable sliding hard cover included
- Weight: 264 g (9.3 oz)
- 1-year warranty



HP 48G Series

- 128KB in both the HP 48G+ and HP 48GX
- 131 x 64-dot display
- 12-digit numeric values with 3-digit exponents
- HP EquationWriter allows "textbook"-formatted equation entry
- Multiple plots on single graph; number of plots limited only by available memory
- Quadratic and polynomial root finders
- Symbolic and numeric integration and differentiation
- Differential equation solver
- Real and complex matrices; sizes and numbers of matrices limited only by available memory
- Object-based user programming language; program sizes and numbers limited only by available memory
- Program structures include FOR, DO, IF, CASE, UNTIL, and WHILE
- Infrared I/O; wireless transfer of instructor data to students
- Plot types include function, conic, polar, parametric, truth, differential equation, bar, histogram, scatter plot
- Graphic controls include zoom, box Z, tracing, shading, spacing, axis tick marks, and scrolling
- Matrix operations include inverse, transpose, determinant, row operations, and row-to-column conversions
- Statistical capabilities include standard deviation, mean, linear regression, combinations, permutations and weighted means
- Keys can be assigned new functions or programs
- Serial-wired PC interface
- Size: 8.1 x 18.0 x 2.9 cm (3.2 x 7.1 x 1.2 inches)
- Weight: 264 g (9.3 oz)
- 1-year warranty
- The HP 48GX has two expansion ports, allowing plug-in applications or RAM memory cards

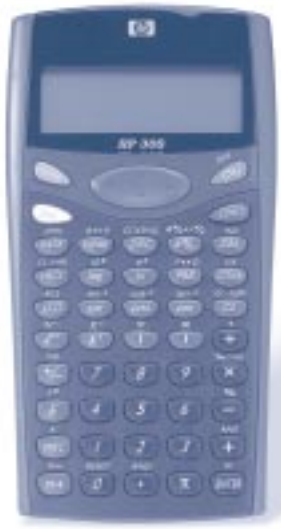
HP 39G

- 131 x 64-pixel (8 lines x 22 char.) display, with Textbook formatting mode for easy recognition
- Over 600 functions, accessed via pop-up display windows
- Electronic lesson ("E-lesson" or "ApLet") modules, limited only by available memory
- Presents mathematical solutions in multiple views
- Split-screen capability displays 2 screens side-by-side for dynamic comparisons

- Notes and sketches
- HP Equation Solver
- Differentiation and integration
- Graph rectangular functions, parametric and polar expressions, recursively-defined sequences
- Multiple graphing functions defined, saved, graphed and analyzed simultaneously
- Multiple functions traceable on a single graph
- Interactive zoom features accessible from the display
- Sequence graphing mode: time series and cobweb/stairstep plot
- Interactive function analysis: values, roots, maxima and minima, integrals, derivatives
- Matrix math and operations
- 1- and 2- variable summary and inferential statistics; regression (linear, log, power, exponential, quadratic, cubic, logistic)
- Histograms, scatter plots, regression equation graphs, box and whisker plots
- Programming (HP Basic)
- Dynamic results history stack
- Factorization, expansion, substitution, linear algebra and linear system solutions
- Polynomial root finding
- Complex numbers, logs, exponentials, combinatorials
- 256 KB memory
- Data transfer with built-in IR (infrared) and serial port
- Connects to a PC, overhead projector, data/lab analyzer
- Powered by 3 AAA batteries
- Sturdy sliding hard case
- 1-year warranty
- Size: 18.7 x 8.9 x 2.8 cm (7.4 x 3.5 x 1.1 inches)
- Weight: 264 g (9.3 oz)

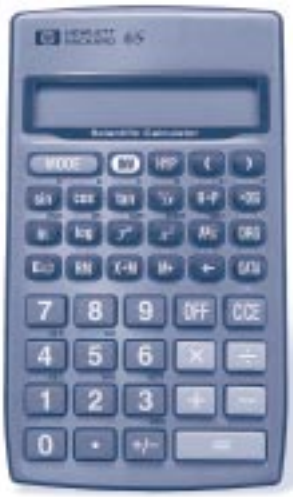
HP 30S

- 2-line display, with editable command line history
- 250 built-in functions
- 10 memory registers
- Enhanced constant mode
- Percentage and percentage change calculations
- Fractions and fraction/decimal conversions
- Trigonometric functions and pi
- Powers, logs, roots and exponential functions
- Polar/rectangular conversions
- Unit conversions
- 11 physical constants
- Univariate and bivariate statistics, with editable data sets
- Hard cover
- Interchangeable faceplates (with two extra colored faceplates included)
- Size: 15.5 x 8.1 x 1.4 cm (6.1 x 3.2 x 0.5 inches)
- Weight: 135 g (4.8 oz)
- 1-year warranty



HP 6S

- 1-line x 10-character display
- Algebraic entry system
- Over 66 built-in functions
- 3 memory registers (plus statistical registers)



- Percentage calculations
- Fractions and fraction/decimal conversions
- Pi, trig and hyperbolic trig functions
- Powers, logs, roots and exponential functions
- Polar/rectangular and angle conversions
- Hours/hour-angle conversions
- Summary and univariate statistics (mean and standard deviation)
- Base conversions and arithmetic
- Bit and boolean operations
- Solar power with battery backup
- Size: 12.7 x 7.2 x 0.8 cm (5.0 x 2.8 x 0.3 inches)
- Weight: 135 g (3.2 oz)
- 1-year warranty

HP Graphic Calculators Side by Side

	Features	HP 49G
Configuration	Scientific programmable graphing calculator	Yes
	User Memory	1.5 MB
	Flash ROM for future electronic software upgrades	Yes
Physical Features	Color	Light metallic blue
	Carry case	Slide-on translucent blue
	High contrast display	Yes, with enhancements
	Dimensions (L×W×D)	7.4×3.5×1.1" (18.7×8.9×2.8cm)
	Weight (with batteries)	9 oz (264 g)
	Display size (W×H)	131×64 pixels LCD
	Number of keys	51
	Infrared port for printing/unit-to-unit communication	No
	Expansion ports for memory and software cards	No
	Serial (RS232) port	Yes, 10-pin
Operating Features	User interface speed	Yes, with enhancements
	Operating modes	RPN/Algebraic (+ textbook formatting)
	Default screen display modes	Textbook/Algebraic
	Default screen stack/history display	Results/objects
	Built-in fonts	4
	Downloadable fonts	Yes
	Font sizes	4
	Cut/paste/copy operations	Yes
	Manipulating and solving sub-expressions	Yes, with enhancements
	Catalogue of functions	Yes
	Object storage (variables and directories)	Yes
	Date and time (including alarm set)	Yes
Math Features	Built-in, dynamic computer algebra system	Yes
	Mathematical constants library	Yes
	Factorization and expansion	Yes
	Substitution	Yes, with enhancements
	Symbolic and numeric differentiation and integration	Yes, with enhancements
	Differential equations	Yes, with enhancements
	Solving systems of linear equations	Yes, with enhancements
	Linear algebra and matrices	Yes, with enhancements
	Symbolic and numeric solve	Yes, with enhancements
	Step-by-step numeric and symbolic solve	Yes, with enhancements
	Complex arithmetic	Yes, with enhancements
	Exponential and logarithmic functions	Yes
	Taylor polynomials	Yes
	Lists and sequences	Yes
	Trigonometry	Yes
	Vector operations	Yes
Scientific Features	Built-in equation library	No
	Physical constants library	Yes
	Units-of-measure library	Yes
	Unit conversions	Yes
Statistical Features	Inferential	Yes
	Descriptive	Yes
Financial Features	Time-value-of-money	Yes
	Amortization	Yes
Customizing Features	Additional memory card options	No
	Supports third party RPL programs, games	Yes
	Programming languages	RPL/Assembly/HP Basic
Graphing Features	Tables	Yes
	15 plot types	Yes
	2D/3D plotting	Yes
	Function analysis	Yes
	Tracing and zooming	Yes
Accessories	Overhead Display Unit (F1212A)	Yes
	Portable DataLab (Firmware Systems, Inc.)	Yes
	PC Connectivity Pack (F1897A)	Yes

HP 48G Series	HP 39G	HP 30S	HP 6S
Yes	Yes	No	No
128 KB	256 KB	10 registers	3 registers + statistic registers
No	No	No	No
Gray	Dark metallic blue	Gray	Bright metallic blue
Soft, dark grey pouch	Slide-over translucent blue	Slide-over, extra face plates	Soft black vinyl
Enhancements	Enhancements	Yes	Yes
7.1×3.2×1.15" (18.0×8.1×2.9cm)	7.4×3.5×1.1" (18.7×8.9×2.8cm)	6.1×3.2×0.5" (15.5×8.1×1.4cm)	5.0×2.8×0.3" (12.7×7.2×0.8cm)
9 oz (264 g)	9 oz (264 g)	4.75 oz (135 g)	3.2 oz (91 g)
131×64 pixels LCD	131×64 pixels LCD	2 line × 10 character LCD	1 line × 10 character LCD
49	51	45	42
Yes	Yes	No	No
Yes (HP 48GX model)	No	No	No
Yes, 4-pin	Yes, 10-pin	No	No
No	Yes	No	No
RPN/Textbook	Algebraic/Textbook	Algebraic	Algebraic
Algebraic	Algebraic/Textbook	Algebraic	Algebraic
Results only	Results/objects	Results only	Results only
3	4	1	1
No	Yes	No	No
3	3	1	1
No	Yes	Constant mode	Constant mode
Yes	No	No	No
No	Yes	No	No
Yes	Variables and E-lessons	No	No
Yes	No	No	No
No	Algebraic manipulations	No	No
Yes	No	No	No
Yes	Yes	Fractions	Fractions
Yes	Yes	Yes	No
Yes	Numeric only	No	No
Yes	No	No	No
Yes	Yes	Yes	No
Yes	Yes	No	No
Yes	Numeric solve	Numeric solve	No
Yes	No	No	No
Yes	Yes	Yes	No
Yes	Yes	Yes	Yes
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	E-lessons (ApLets)	No	No
Yes	No	Yes	No
Yes	No	No	No
Yes	No	Yes	No
No	Yes	No	No
Yes	Yes	Yes	Yes
Yes	No	No	No
Yes	No	No	No
128KB, 1MB	No	No	No
Yes	No	No	No
RPL	HP Basic	None	None
No	Yes	No	No
Yes	E-lessons, w/viewing options	No	No
Yes	2D only	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No

Accessories for HP Graphic Calculators

Classroom Overhead Display

The Overhead Display Unit (ODU) is a great way to present lessons, showing HP 38G, HP 39G, HP 48GX or HP 49G calculations to the whole class, step by step. Just set this unit on an overhead projector, connect your calculator, adjust the contrast, and you're ready for class. The ODU comes with cables for the HP 38G, HP 39G, HP 48SX/GX and HP 49G, and built-in cable storage.

HP F1212A Overhead Display Unit
Includes the display unit, one 9V battery, 2 cables and a User's Guide.

Memory Cards

Take advantage of additional RAM—store more data and large programs in your HP 48GX! Choose the memory configuration you need: add to the main memory or use the plug-in card as an electronic disk. Your information is saved even when you unplug the RAM card—each card has its own long-lasting battery!

HP 82215A 128 KB Battery-backed RAM Card, for the HP 48GX
Includes a 128 KB battery-backed RAM card, CR2016 battery, installation card.

HP 82216A 1 MB Battery-backed RAM Card, for HP 48GX
Includes a 1 MB battery backed RAM Card, CR2016 battery, installation card.

Other Accessories

There's lots of concise information in book form for HP 48G Series calculators—replacement Owner's Manuals or extra help on programming and other topics.

00048-90136 HP 48G Series Advanced User's Reference Manual
Programming techniques and examples, tables of commands, equations, system messages, units, system flags and reserved variables.

00048-90126 HP 48G Series Replacement O. Manual & Quick Start Guide

82221-60001 Soft Case, replacement case for HP 48 Series

Connectivity

You can share your computer's peripherals with the HP 38G, HP 39G, HP 48G Series and HP 49G—and protect your calculator data and programs by storing them to your computer's disk drive. The HP Connectivity Pack provides desktop computer cables and utilities (including Windows-compatible programs) to capture HP 38G, HP 39G, HP 48G Series or HP 49G screen images.

F1897A Serial Interface Pack for IBM-compatible PC's

Program transfers files (libraries, programs, grobs, data sets, or ApLets) between calculator and computer. Includes screen capture/save utility. Controls HP 48G Series memory from the computer. Includes 1.5-meter serial cable, 4-pin to 10-pin connector, CD-ROM with PC software (Windows 95/98/NT4.0 and Win2000 versions), User's Guide; requires open PC serial port (9-pin to 25-pin).

F1015A Serial Interface Cable for IBM-compatible PC's

Includes 1.5-meter serial cable, 4-pin to 10-pin connector.

Printing

The battery-powered infrared printer is a revolutionary companion for your HP graphic calculator—now with easier-to-read output and automatic shutoff to extend battery life. Using an invisible infrared beam, it needs no cord to connect to the calculator, so producing hard copies in the field or office couldn't be easier! Just aim your calculator at the printer (up to 18 inches away), send print instructions, and you get a neat, clean copy of your calculations. Just 4 AA alkaline batteries give the printer go-anywhere portability—or use the optional AC adapter as you wish.

HP 82240B HP Infrared Printer

Includes: Printer, 4 AA alkaline batteries, 1 roll of paper, User's Guide.

HP 82175A Thermal Paper for HP 82240B or HP 82240A Infrared Printers

Includes: 6 rolls, 2 1/4" x 80" (5.7 cm x 25 cm), black.

HP F1011A AC Adapter for HP 82240B or HP 82240A Infrared Printers

Where to Buy:
HP Graphic Calculators and Accessories

Distributors

Axidata (Canada)...514-738-6996
Azerty...check local area listings
Beamscope (Canada)...905-763-3000
Carolina Wholesale...check local area listings
Commonwealth...check local area listings
D&H Distributors...800-877-1200
Daisytek (Canada)...905-940-9800
Douglas Stewart Co....800-279-2795
El Dorado Trading Co....800-227-8292
Hartco Enterprises/MultiMicro (Canada)...514-354-0580
NEAMCO...800-937-1300
PRO Distributors...212-840-6830
Taylor...check local area listings
United Stationers...check local area listings

National Retailers

Best Buy...check local area listings
Boise Cascade...check local area listings
Business Depot (Canada)...905-513-6116
CDW Computer...check local area listings
Circuit City...check local area listings
Corporate Express...check local area listings
CostCo...check local area listings
Fry's Electronics...408-487-1000
J&R Computer World...800-221-8180
Nobody Beats the Wiz...800-846-NBTW
Office Depot...800-685-8800
Office Depot/Office Place (Canada)...905-615-0980
OfficeMax...800-788-8080
S.P. Richards...check local area listings
Service Merchandise...800-251-1212
Staples...800-333-3330
Walmart...check local area listings

Local and Independent Retailers

Alabama

Auburn University Bookstore...1360 Haley Center...Auburn, AL 36849...334-844-1354
Off Campus College Bkstr....1020 Henderson Rd....Huntsville, AL 35816...205-837-9529
University Supply...P.O. Box 870291...Tuscaloosa, AL 35487...205-348-6168

Alaska

Lewis & Lewis Computer Store...611 Fairbank St....Anchorage, AK 99501...907-277-9432
Alaska Pacific Univ. Bkstr....4101 Univ. Dr....Anchorage, AK 99608-4625...907-564-8218
Univ. of Alaska...2905 Providence Dr....Anchorage, AK 99508-4630...907-786-4759
University of Alaska...PO Box 750127...Fairbanks, AK 99775-0001...907-474-7348

Arizona

Computer Physicians Unlimited...10211 N. 60th Dr....Glendale, AZ 85302-1255
Arizona State University Bookstore...Tempe, AZ 86287-0310...602-965-7928
Arizona Bookstore...815 N. Park Ave....Tucson, AZ 85719...520-622-4717
University of Arizona Bookstore...850 E. 18th St....Tucson, AZ 85719...520-621-8870

California

ASUC Store...Bancroft at Telegraph...Berkeley, CA 94720...510-642-7010
Associated Students Bookstore...Chico, CA 95929-0001
Off Campus Bookstore...236 A St....Davis, CA 95616...916-758-2665
UC Davis Bookstore...Davis, CA 95616...916-752-5907
Kennel Bookstore...Fresno, CA 93740-0022...209-278-4062
UCI Bookstore...Irvine, CA 92717-1550...714-824-7877
UCSD Bookstore...Mail Code 0008...La Jolla, CA 92093-0008...619-534-7095
Forty Niner Shops, Inc.....6049 E. 7th St....Long Beach, CA 90840-0001...562-985-7704
UCLA Student's Store...308 Westwood Blvd....Los Angeles, CA 90024...310-206-0825
University Bookstore...840 Childs Way...Los Angeles, CA 90089-0009...213-740-8993
Matador Bookstore...18111 Nordhoff St....Northridge, CA 91330-0001
Titan Shops...2875 Orange-Olive Rd....Orange, CA 92665
Bronco Bookstore...CA St Ply U Building 66...Pomona, CA 91768-2557...909-869-3274
Golden State Bus. Sys.....1787 Tribute Rd., Suite E...Sacramento, CA 95815...916-922-9221
Hornet Bookstore...6000 J St....Sacramento, CA 95819-2605...916-278-7297
Adams Office Supply...3038 University Ave....San Diego, CA 92104-3072...619-295-4131
Aztec Shops Ltd.....San Diego, CA 92182-1701...619-594-7508
USD Bookstore...5998 Alcala Park...San Diego, CA 92110...619-260-4551
Franciscan Bookstore...1650 Holloway Ave....San Francisco, CA 94132-1781...415-338-7369
Spartan Bookstore...San Jose, CA 95112...408-924-1817
El Corral Bookstore...San Luis Obispo, CA 93407...805-756-1101
UCSB Bookstore...University Center...Santa Barbara, CA 93107-3400...805-893-8579
Stanford Bookstore...Stanford, CA 94305-3079...800-533-2670
Mawson Computer...3343 Industrial Dr., Ste. 1...Santa Rosa, CA 95403...707-528-2841

Colorado

University Book Center...Campus Box 36...Boulder, CO 80309...303-492-6411
Cadet Bkstr.....Bldg. 2360, Vandenburg Hall...USAF Academy, CO 80841...719-472-6268
Follett's CSM Bkstr.....Ben Parker Student Ctr....Golden, CO 80401-1887...303-273-3113

District of Columbia

Follett's GWU Bkstr.....2110 "I" St., N.W....Washington D.C 20052-0001...202-994-6870

Florida

Univ. of Miami Bookstore...University Center...Coral Gables, FL 33124...305-284-3592
ERAU Bkstr....Embry-Riddle Aero. Univ....Daytona Beach, FL 32114...904-226-6062
Florida Bkstr. & Comp. Ctr....1614 W. Univ. Ave....Gainesville, FL 32604...904-376-5606
University Book & Supply...1227 W. University Ave....Gainesville, FL 32601...904-377-1788
Univ. of Florida Bookstore...Stadium Rd.-Hub...Gainesville, FL 32611-2011...904-392-0194
International Calculator...2916 Corrine Dr....Orlando, FL 32803...800-535-5692
UCF Computer Store...4000 C. Florida Blvd....Orlando, FL 32816...407-823-0145
University Bookstore...P.O. Box 25001...Orlando, FL 32816-0444...407-823-3028
Mayes Office Supply...6120 Pensacola Blvd....Pensacola, FL 32589...904-477-1111
FSU Store...New Union Bldg. #0127...Tallahassee, FL 32306...904-644-2072
USF Bookstore...4202 Fowler Ave....Tampa, FL 33620-6550...813-974-0523

Georgia

Allen Precision Equipment...3427 Oakcliff Rd....Atlanta, GA 30340...800-241-6223
Engineers Bookstore...748 Marietta St., N.W....Atlanta, GA 30318...404-221-1669
Georgia Tech Bookstore...Atlanta, GA 30332-0001...404-894-2513
Allen Precision Equipment, Inc....1550 Boggs Rd....Duluth, GA 30136...770-458-8885
Southern Tech Bookstore...Marietta, GA 30060-2896...770-528-7355
A. Baldwin Ag. College Bkstr....2802 Moore Hwy....Tifton, GA 31793-0016...912-386-3226

Hawaii

Univ. of Hawaii Bookstore...2465 Campus Rd....Honolulu, HI 96822-2216...808-956-6612

Idaho

Oregon Digital...5511 Kendall St....Boise, ID 83706...208-377-1521
University of Idaho Bookstore...Moscow, ID 83843...208-885-6469
Ricks College Bookstore...Manwaring Center 116...Rexburg, ID 83460-2211...208-356-2211

Illinois

Illini Union Bookstore...715 S. Wright St....Champaign, IL 61820...217-333-2050
Follett College Store...627 S. Wright St....Champaign, IL 61820-5709...217-356-1368
TIS Bookstore...707 South 6th St....Champaign, IL 61820-5716...217-337-4900
Follett's Commons...3200 S. Wabash Ave....Chicago 60616-3821...312-791-0770
Student Book Exch., Inc....1737 Sherman Ave....Evanston, IL 60201-3712...847-328-2717
The Alamo II...319 North St....Normal, IL 61761-8100...309-452-7400
Book Center in the Illini Union...Urbana, IL 61801-2917...217-244-3743
The Write Stuff, Inc....1 S. 781 Country Club...Wheaton, IL 60564-5646...708-871-8545

Indiana

Purdue Bookstore...Library Building...Hammond, IN 46323-2051...219-844-1081
IUPUI Cavanaugh Bookstore...425 Univ. Blvd....Indianapolis, IN 46202...317-278-BOOK
IUPUI Union Bookstore...620 Union Dr....Indianapolis, IN 46202...317-274-7167
Follett's Purdue West...1400 W. State St....West Lafayette, IN 47906-3405...765-743-9642
University Book Store...360 State St....West Lafayette, IN 47906...765-743-9618

Iowa

Campus Bookstore...2300 Lincoln Way...Ames, IA 50010...515-292-1616
Iowa Book & Supply Co....Box 2030...Iowa City, IA 52240-3912...319-337-4188
University Bookstore...Iowa Memorial Union...Iowa City, IA 52242...319-335-3179

Kansas

Kansas Union Bookstore...Jayhawk Blvd....Lawrence, KS 66045-0501...913-864-4640
University Book Shop...1116 W. 23rd St....Lawrence, KS 66045...913-749-5209
K-State Union Bookstore...Manhattan, KS 66506-2809...913-532-6583
University Book Store...623 N. Manhattan...Manhattan, KS 66502-5333...913-539-0511

Kentucky

University Book Store...106 Student Center...Lexington, KY 40506-0001...606-257-6304

Louisiana

Louisiana State Univ. Bkstr....110 Union Bldg....Baton Rouge, LA 70893...504-388-5137
University Bookstore...P.O. Box 41209 USL...Lafayette, LA 70504-1209...318-482-6922
Comp. Store of Louisiana...1440 Canal Street...New Orleans, LA 70112...504-486-9055

Maine

Maine Surveyors Supply...28 U.S. Route 1...Yarmouth, ME 04096...207-846-5143

Maryland

U.S. Naval Academy Store...101 Wilson Rd....Annapolis, MD 21402-5081
Maryland Book Exch....4500 College Ave....College Park, MD 27040...301-927-2510

Massachusetts	**The University Shop**...Campus Center...Amherst, MA 01003-0146...413-545-2619
	Boston University Bookstore...660 Beacon St....Boston, MA 02215...617-267-8484
	Campus Camera & Video...660 Beacon St....Boston, MA 02215...617-236-7476
	Harvard Coop...1400 Mass. Ave....Cambridge, MA 02238...617-499-2000
	Tek Calc...Stoneham, MA 02180...781-438-7346
	Wholesale Products, Inc....18 Kenneth Terr....Stoneham, MA 02180...781-438-8622
	Worcester Polytechnic Institute...Daniel Hall...Worcester, MA 01609...508-831-5247
Michigan	**Ulrich's**...549 E. University Ave....Ann Arbor, MI 48104...313-662-3201
	Lundberg Bkstr....Rankin Ctr....805 Campus Dr....Big Rapids, MI 49307...616-592-2607
	Instrument Sales & Service...24037 Acacia...Bretford, MI 48239...313-535-5252
	Gibson's Tech. Bkstr....128 W. Grand River Ave....East Lansing, MI 48823...517-332-8681
	MSU Bookstore...East Lansing, MI 48824-1035...517-355-3450
	Mott College Store...1401 E. Court St....Flint, MI 48502...810-762-0232
	Michigan Surveyors Supply...4655 Willoughby...Holt, MI 48842-2162...517-694-4600
	Michigan Tech Bookstore...1503 College Ave....Houghton, MI 49931-1295...906-487-2410
	Western Michigan University...Bernhard Center...Kalamazoo, MI 49008...616-387-3930
	SSI Solutions, Inc....Westland, MI 48185
Minnesota	**Univ. Ctr. Bkstr.**...175 Kirby Student Ctr....10 Univ. Dr....Duluth, MN 55812...218-726-7286
	Harold Smith Bookstore...259 19th Ave., S....Minneapolis, MN 55455...612-626-0522
	Office Products of Minn....7794 Bush Lake Rd....Minneapolis, MN 55439...612-835-6776
	Univ. of Minn. Bookstore...231 Pillsbury Dr., S.E....Minneapolis, MN 55455...612-626-1782
Mississippi	**Miss. State Univ. Bkstr.**...Colvard Student Union...Miss. State, MS 39762...601-325-1576
Missouri	**University Bookstore**...Brady Commons...Columbia, MO 65201...573-882-7611
	Rolla Bookstore...788 University Center, W....Rolla, MO 65401...314-341-4705
	Washington Univ. Bookstore...One Brookings Dr....St. Louis, MO 63130...314-935-5500
	University Store...University Union 128...Warrensburg, MO 64093...816-543-4801
Montana	**MSU Bookstore**...185 Student Union...Bozeman, MT 59717-0020...406-994-5836
	Montana Tech Bookstore...W. Park St....Butte, MT 59701...406-496-4190
Nebraska	**CRC Computer Store**...501 N. 10th St., Rm. 123...Lincoln, NE 68588-0200...402-472-8444
	Nebraska Bookstore...1300 Q St....Lincoln, NE 68508...402-476-0111
Nevada	**A.S.U.N. Bookstore**...Reno, NV 89507-8049...702-784-6597
New Hampshire	**Dartmouth College**...33 South Maine St....Dartmouth, NH 03755...603-643-3616
New Jersey	**Campus Store**...Castle Point Station...Hoboken, NJ 07030...201-420-5101
	New Jersey Inst. of Tech....150 Bleeker St....Newark, NJ 07103-3902...973-596-3200
	Princeton Univ. Store...36 University Place...Princeton, NJ 08540-5116...609-921-8500
New Mexico	**Holman's Inc.**...420 Wisconsin St., N.E....Albuquerque, NM 87123...505-343-0007
	Univ. of New Mexico Bookstore...Main Campus...Albuquerque, NM 87131...505-277-6364
	New Mexico State Univ. Bkstr....Corbett Center...Las Cruces, NM 88001...505-646-4431
New York	**Follett's Univ. Bookstore**...200 Lee Entrance...Buffalo, NY 14260-0001...716-645-3131
	Collegetown of Ithaca, Inc....111 N. Aurora Street...Ithaca, NY 14850-4301...607-272-4477
	47th Street Photo...New York, NY...212-921-1287
	Columbia Univ. Bookstore...2926 Broadway...New York, NY 10027-7088...212-854-4131
	NY Inst. of Tech. Bookstr....Student Lecture Ctr....Old Westbury, NY 11568...516-686-7584
	BASIX...Stony Brook Union, Rm. 046...Stony Brook, NY 11794-0001...516-632-9281
	Orange Student Bkstr....Marshall Square Mall...Syracuse, NY 13210-1731...315-478-6821
	Syracuse Univ. Bookstore...303 University Pl....Syracuse, NY 13244-0001...315-443-1647
	ITS Product Ctr....Rensselaer Polytechnic Institute...Troy, NY 12180-3590...518-276-8164
	Rensselaer Union Bookstore...Sage & 15th St....Troy, NY 12181...518-276-4021

North Carolina

Surveyors Supply Co....1511 N. Salem St....Apex, NC 27502...919-362-7000
Southern Photo & Supply...734 Chapel Hill Rd....Burlington, NC 27215...910-227-3477
Duke University Stores...PO Box 90850...Durham, NC 27708...919-684-2344
Southern Photo & Supply...314 E. Russell St....Fayetteville, NC 28301...919-483-4909
NC A&T Bookstore...Brown Hall...Greensboro, NC 27411-0001...910-334-7593
Southern Photo & Supply...340 N. Wrenn St....High Point, NC 27260...919-882-3127
Addam's Univ. Bkstr.....2109 Avent Ferry Rd....Raleigh, NC 27606-2137...919-832-9938
DJ's Textbooks...2416 Hillsborough St....Raleigh, NC 27607-7248...919-787-3512
NCSU Bookstore...Dunn Ave....Raleigh, NC 27695-0001...919-515-2161

North Dakota

Varsity Mart...PO Box 5476...Fargo, ND 58105-7761
Univ. of N. Dakota...Univ. Station, Campus Dr....Grand Forks, ND 58202...701-777-2681

Ohio

Safe Technologies Corp.....4131 State Park Dr....Akron, OH 44319...800-638-9121
College Book Store...50 S. Court St....Athens, OH 45701...614-594-3505
Univ. of Cincinnati Bkstr.....123 W. Univ. Ave., ML 217...Cincinnati, OH 45221...513-556-1900
Long's College Book Co.....1836 N. High St....Columbus, OH 43201-1146...614-294-4674
Ohio State Univ. Bookstore...2009 Millikin Rd....Columbus, OH 43210...614-292-2991
Case Western Reserve Univ.....11111 Euclid Ave....Cleveland, OH 44106...216-368-2650
University Bookstore...Thwing Center...Cleveland, OH 44106-1715...216-368-2650

Oklahoma

OU Computer Store...Norman, OK 73019...405-325-1925
Union Bookstore...900 Asp...Norman, OK 73019-0001...405-325-2171
Applied Computer Systems...2726 Classen...Oklahoma City, OK 73106...405-524-6852
Cowboy Books, Ltd.....109 N. Knoblock...Stillwater, OK 74074...405-743-1383
Smith's Bookstore...301 S. Washington...Stillwater, OK 74074-3332
Copier and Computer Systems...6136 E St....Tulsa, OK 74135...918-622-0612

Oregon

CalcPro...33890 S.E. Eastgate Circle...Corvallis, OR 97333...888-200-4220
Corvallis System Sales...800 N.W. Starker, Ste. 35...Corvallis, OR 97330...541-752-4419
OSU Bookstore...2301 S.W. Jefferson...Corvallis, OR 97331...541-737-4323
University of Oregon Bookstore...895 E. 19th Ave....Eugene, OR 97401...541-346-4331
Paper Owl Bookstore...3201 Campus Dr....Klamath Falls, OR 97601...541-885-1050
Portland Comm. Coll. Bkstr.....1200 S.W. 49th Ave....Portland, OR 97219...503-977-4910
Power Source – PSU Bookstore...626 S.W. College...Portland, OR 97201...503-295-1130
Chemeketa Comm. College Bkstr.....P.O. Box 14007...Salem, OR 97309...503-399-5131

Pennsylvania

Lehigh Univ. Bkstr.....Maginnes Hall, Bldg. 9...Bethlehem, PA 18015-3073...610-758-3376
Drexel University Store...33rd & Chestnut St....Philadelphia, PA 19104...215-895-2855
Temple Univ. Bkstr.....13th & Montgomery Ave....Philadelphia, PA 19122...215-204-7385
Univ. of Penn. Bkstr.....3729 Locust Walk...Philadelphia, PA 19104-3610...215-898-7595
CMU Bookstore...Baker Hall, Schenley Pk....Pittsburgh, PA 15213...412-268-2966
Penn State Bookstore...Bookstore Bldg....University City, PA 16802...814-863-3250

Puerto Rico

Relojes y Calculadoras...Mayaguez Mall...Manaquer, PR 00680...787-834-5559
HP Only...Binero Avenue #1031...Puerto Nuevo, PR 00920...787-793-8033

Rhode Island

Brown Univ. Bookstore...71244 Thayer St....Providence, RI 02912-0001...401-863-3216

South Carolina

J & J Electric...384-7 College Ave....Clemson, SC 29631...864-654-3663
Clemson Bookstore...P.O. Box 2096...Clemson, SC 29632-2096...864-656-2050
Student Off-Campus Bkstr.....359 College Ave....Clemson, SC 29633...864-654-3000
Carolina's...629B Main...Columbia, SC 29201...803-799-7406
Follett's Addam's Univ. Bkstr.....601 Main St....Columbia, SC 29201-4058...803-256-6666
Follett's Univ. Bkstr.....The Russel House...Columbia, SC 29208-0001...803-777-4160

South Dakota	**Tech Bookstore**...501 E St....Rapid City, SD 57701...605-871-1984
Tennessee	**University Center Bookstore**...Box 5075...Cookville, TN 38505...931-372-3226
	Surveyors Module, Inc.....412 Payne Ridge Rd....Church Hill, TN 37642...423-357-8931
	Univ. Book & Supply...U.T. Center, Rm. 147...Knoxville, TN 37916-4800...423-974-1040
Texas	**University Cooperative Society**...2246 Guadalupe...Austin, TX 78705...512-476-7211
	Professional Computing...505 Church St....College Station, TX 77840...409-846-5332
	U Bookstores & Aggie...700 Univ. Dr., E....College Station, TX 77840...409-846-4818
	CompuCom Systems, Inc.....9333 Forest Ln....Dallas, TX 75243...972-783-1252
	Holman's...5776 N. Mesa...El Paso, TX 79936
	Century Business Equipment...6810 Larkwood...Houston, TX 77074...713-777-2673
	Rice Campus Store...6100 S. Main St....Houston, TX 77005...713-527-4052
	Executive World...3312 Santa Ursula Ave....Laredo, TX 78040...956-722-6385
	Palmtop Connection...6814 Leyland...San Antonio, TX 78239...210-590-7444
Utah	**Utah State University Bookstore**...Logan, UT 84322...801-797-1667
	Weber State University Bookstore...Ogden, UT 84408-2103...801-626-6352
	BYU Bookstore...Provo, UT 84602...801-378-6808
	University Bookstore...Salt Lake City, UT 84112...801-581-3582
	R H Enterprises, Inc.....3601 S. 2700 W....West Valley City, UT 84119...801-576-8301
Virginia	**Tech Bookstore**...118 S. Maine St....Blacksburg, VA 24060...703-552-6444
	Southern Photo & Supply...3813 Old Forest Rd....Lynchburg, VA 24502...804-385-6060
Washington	**Student Book Corp.**....N.E. 700 Thatuna...Pullman, WA 99163...509-332-2537
	Univ. of Washington Bkstr.....4326 Univ. Way, N.E....Seattle, WA 98105...206-634-3400
	Pacific Lutheran Bookstore...Tacoma, WA 98447...253-535-7665
Wisconsin	**Weiherts Bus. Machines**...18050 Continental Dr....Brookfield, WI 53045...414-782-0909
	Your One-Stop Palmtop Shop...170 S. Jackson St....Janesville, WI 53545...800-709-9494
	University Bookstore...711 State St....Madison, WI 53703...608-257-3784
	Ace Electronics...1540 N. 68th St....Milwaukee, WI 53213-2806...414-771-8484
	B J TV Service...3429 S. 13th St....Milwaukee, WI 53215-5011...414-643-8555
	Blue & Koepsell, Inc.....739 N. Mayfair Rd....Milwaukee, WI 53226-4281...414-476-5041
	The H. H. West Co.....P.O. Box 1570...Milwaukee, WI 53233-1570...414-344-1000
	Tele-Port, Inc.....7120 W. Good Hope Rd....Milwaukee, WI 53223-4611...414-358-1923
	University of Wisconsin Bookstore...Milwaukee, WI
	University Bookstore...Student Center...Platteville, WI 53818...608-342-1486
Alberta	**Univ. of Calgary Bookstore**...2500 Univ. Dr., N.W....Calgary T2N 1N4...403-220-4765
	Trentech Office Products...2828 18th St., N.E., #3...Calgary T2E 7B1...403-250-9267
British Columbia	**UBC Bookstore**...6200 University Blvd....Vancouver V6T 1Z4...604-822-2665
	Cariboo College Bookstore...900 College Dr....Kamloops V2C 5N3...250-828-5141
Nova Scotia	**St. Francis Xavier University Bookstore**...Antigonich B2G 1C0...902-867-2450
	Bkstr. – Tech. Univ. of Nova Scotia...P.O. Box 1000...Halifax B3J 2X4...902-420-7707
Ontario	**McMaster University Bookstore**...1280 Main St., W....Hamilton L8S 4L8...905-525-9140
	Queens Univ. Campus Bkstr.....Queens Univ. Grounds...Kingston K7L 3N6...613-545-2955
	Downtown Electronics...356 Yonge Street...Toronto M5B 1S5
	University of Waterloo Bookstore...200 University Ave., W....Waterloo N2L 3G1
Quebec	**COOP Concordia**...1455 de Maisonneuve, O....Montreal H3G 1M8...514-848-3615
Saskatchewan	**Univ. of Saskatchewan Bookstore**...Marquis Hall...Saskatoon S7N 0W0...306-966-4468

HP news as it happens

Stay Apprised, Get a Prize

"You could have mail!"

If you've visited HP's calculator web site (www.hp.com/calculators) in the past year or two, you probably know already: Each issue of **hp^{c}** is posted there in its entirety—usually before the paper version ever hits the streets.

Want a friendly reminder next time?

Just let HP know—but soon! If you're already a subscriber to **hp^{c}**, just send a message noting that, along with your e-mail address, to **hp@bbs.mlc.pdx.edu**, by June 30. If you're not yet a subscriber to **hp^{c}**, this is a great time to start. Use the form on the inside back cover here—be sure to give both your e-mail and postal addresses—and get your subscription in by June 30.

Why the deadline?

Prizes are at stake: Handsome briefcases will go to the first 50 respondents, and HP 30S calculators will go to the next 100—and every entrant in by the deadline will receive something (so don't forget to include your postal address along with your e-mail address). But it all wraps up at the end of June, so take just a moment right now. You'll get more HP calculator news, more often, more easily—and as always, it's FREE.

In case you're wondering:

No, HP will **not** sell or rent your name or address to any outside marketeers. They simply want to offer you an additional way to stay informed of news and resources for HP calculators, quicker and easier than ever (and speaking of which, see page 3). They know you're busy, and their aim is to help you be even more productive, while minimizing demands on your time or energy.

Such a deal.

hp^{c} is available as a free subscription, mailed to your home or school. To subscribe (or to change your address), please contact **MLC** (see page 5) or use the tear-out response card on the inside back cover. -->

Please send all comments and letters to the editor to the address on the inside front cover.

If you have an idea for a feature article or other such material, please contact Chris Coffin at 541.754.0583 or chris@readgpi.com.

If you have an idea for a technical article or sample lesson, please contact Dianne Hart at 541.917.4627 or hartd@gw.lbcc.cc.or.us.