


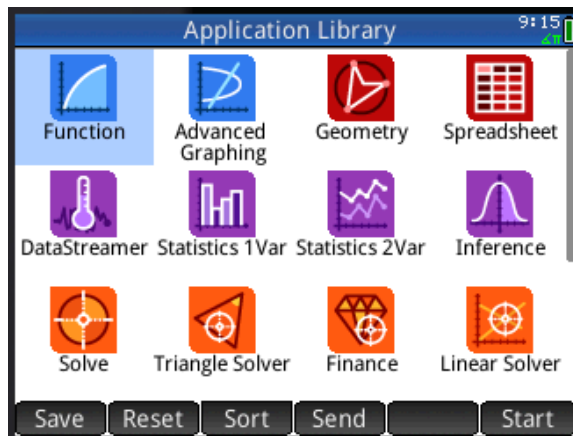
## HP Prime Advanced Graphing Calculator

HP Prime is the latest advanced graphing calculator from Hewlett-Packard. It incorporates a full-color, multi-touch screen and comes pre-loaded with 18 HP Apps. HP Prime also has a Home view, with a history of your numerical calculations, as well as a CAS view, with a history of your symbolic computations.

HP Prime has three design principles:

- Provide a high degree of mathematical fidelity across multiple mathematical representations
- Give students the interactive experiences with technology that they have come to expect
- Deliver a simple and seamless experience for mathematical exploration and problem-solving

HP Apps are designed to explore mathematical topics or solve problems. All HP Apps have a similar structure, with numeric, graphic and symbolic views to make them easy to learn and easy to use. Press  to see the App Library. Drag with your finger to browse the library, then tap the icon of the app you want to use.



The HP Apps are color-coded for easy identification:

- **4 Solver Apps (orange)** for solving specific types of problems (triangles, finance, linear systems) and a general solver for equations and non-linear systems
- **4 Statistics Apps (purple)** for descriptive and inferential statistics and data collection
- **4 graphing apps (blue)** to explore graphs and tables of values
- **3 Explorer Apps (green)** for investigating the relationship between the parameters of a function and the shape of the function's graph

In addition to these apps, there are four more apps of particular interest:

- The Advanced Graphing App allows you to plot and explore the graphs of functions and relations in  $x$  and  $y$ , including implicit relations, inequalities, and conic sections
- The Geometry App gives you the features of a dynamic geometry application, but with a Symbolic view for defining geometric objects exactly using the CAS
- The Spreadsheet App gives you the features of a spreadsheet with the power of a CAS
- The Data Streamer app lets you collect data from sensors quickly and easily


In this brief introduction to HP Prime, we will examine these four apps, but first we will look at the Function App.


## The Function App

The Function App gives you all the tools you need to explore the properties of functions, including plotting their graphs, creating tables of values, and finding roots, critical points, etc.

Tap on the Function App icon and it opens in the Symbolic view. Enter a function using the 2-D textbook format editor.

Choose a color for each of your graphs from the color picker.



Press  to see the graphs of your functions.

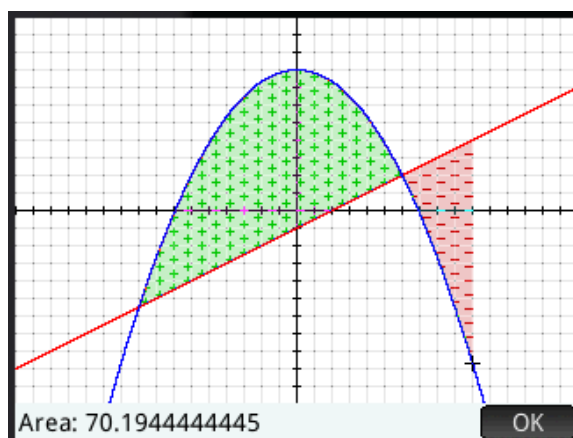
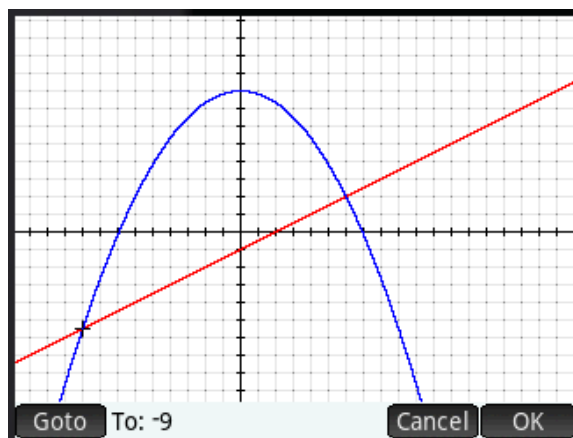
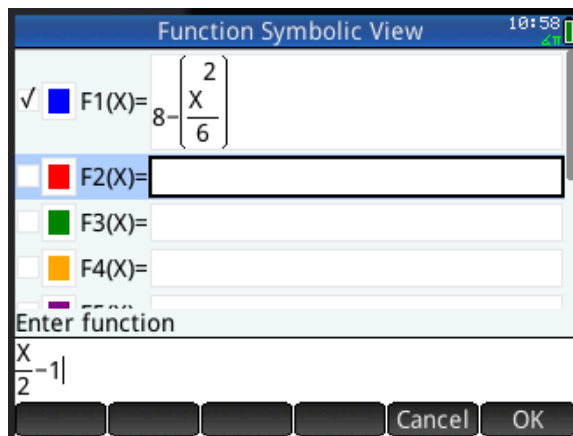
In the Plot view, tap  and then tap an option. We will use the Signed Area function.

You can find the signed area between the two graphs. Just tap near the starting point and then use the arrow keys to get the exact point you want.

Now tap near the end point and again use the arrow keys to get the exact value. With the touch display, the experience is more responsive and interactive.

The color display shows you which regions have positive area and which have negative area.

You can use your finger to drag, which scrolls you through the window. You can also press  and  to zoom in and out on the cursor. No more going back and forth between the plot and the window settings!






## The Advanced Graphing App




The Advanced Graphing App is designed to plot the graphs of conic sections, polynomials, inequalities – virtually any mathematical open sentence in X and Y.

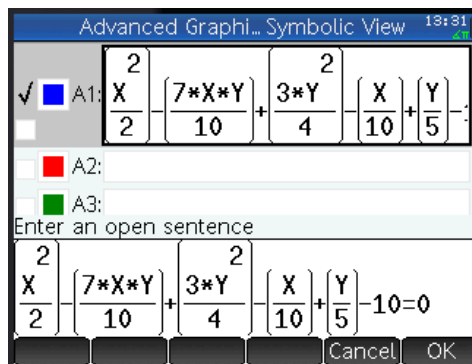
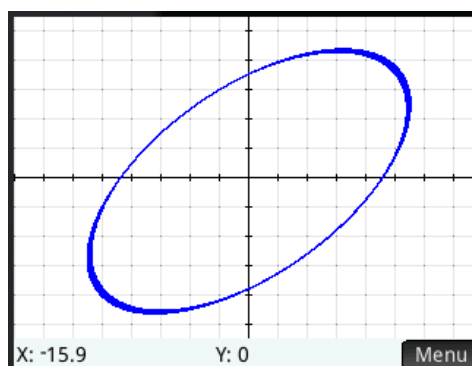
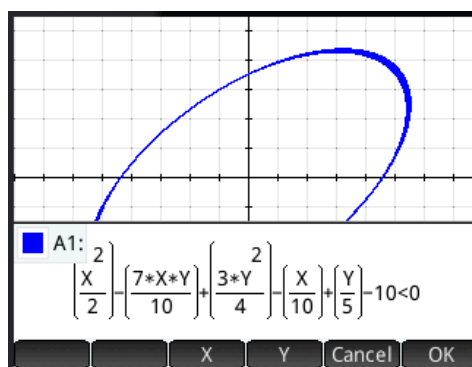
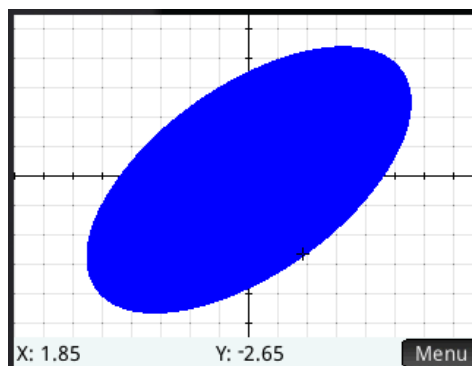
Tap the icon to see the Symbolic View and enter an open sentence in X and Y using the 2-D editor.

Here we enter a rotated conic in general form; in this case, an ellipse.

Use the color picker to choose a color for your graph.

Now press  to see the graph of this rotated conic section. Drag your finger to scroll the window, or use  and  to zoom in and out. The touch interface makes it easy to adjust the graph without leaving the Plot view.

While in the Plot view, tap  and  to view and edit the equation-again without leaving the Plot view. Change the equal sign to < and then tap  to see the new graph.

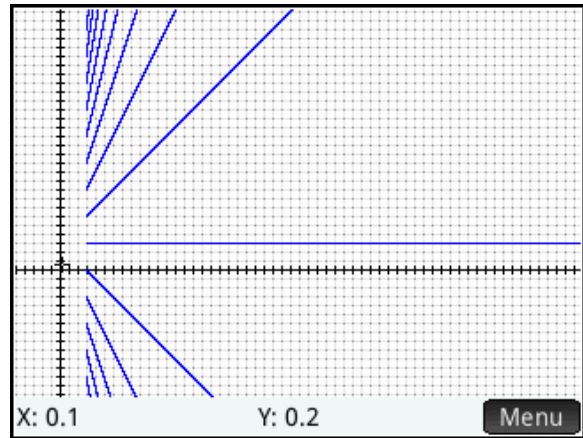





The Advanced Graphing App can handle all of the following with ease:

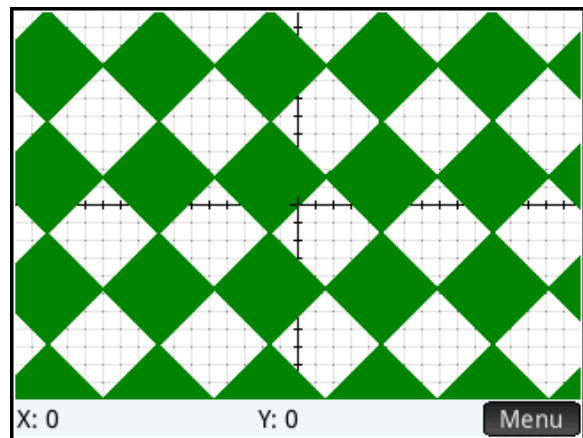
- Conic sections (rotated ones, too)
- Polynomials in standard or general form
- Inequalities (not just linear)
- Functions

In addition, it can handle graphs you have not thought about, like the figures to the right.

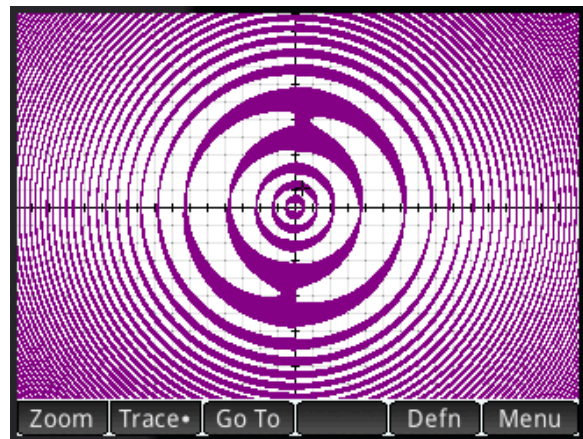
There are new teaching opportunities for you and new learning opportunities for your students with the Advanced Graphing App!



$$y \text{ Mod } x = 3$$



$$\text{Sin}(x) < \text{Sin}(y)$$

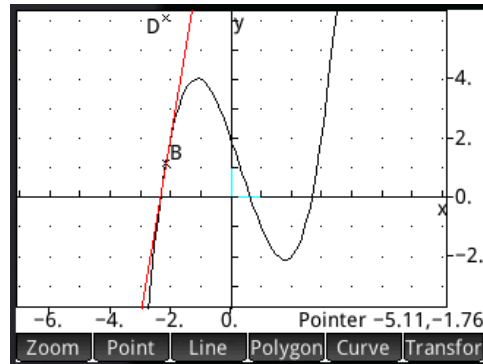


$$\text{Sin}\left(\left(\sqrt{x^2 + y^2} - 5\right)^2\right) > \text{Sin}\left(\text{Tan}^{-1}\left(\frac{y}{x}\right)\right)$$

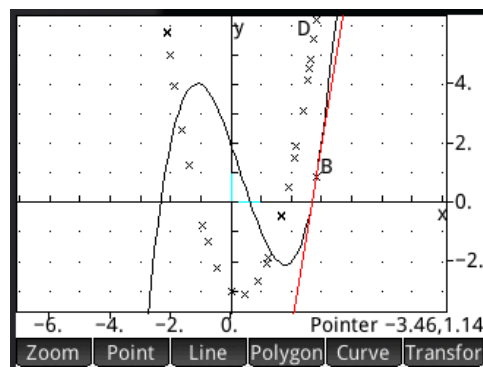
### The Geometry App

The Geometry App is a dynamic geometry application that allows you to create geometric constructions and explore their properties interactively.

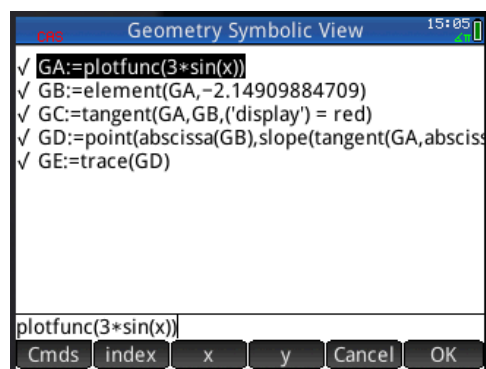
In this construction, point B is the point of tangency for the red tangent line. The graph in black is a cubic function.



Point D has the same x-coordinate as point B but its y-coordinate is equal to the slope of the tangent line. As point B moves along the curve, point D traces out the derivative of the curve.

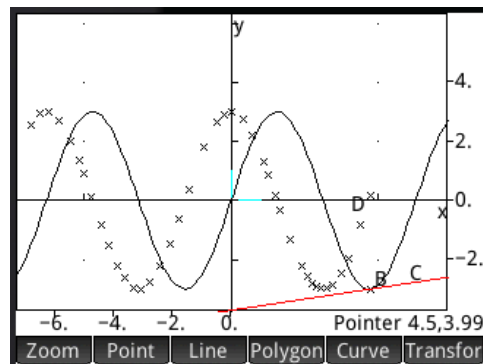


The Symbolic view of the app shows the definition of each object in the Plot view. You can edit these definitions directly or create new objects in this view. Check the ones you want to show in the Plot view and uncheck the ones you want to hide. Change the graph being plotted in GA to  $y=3\sin(x)$ . Point D still traces out the derivative.



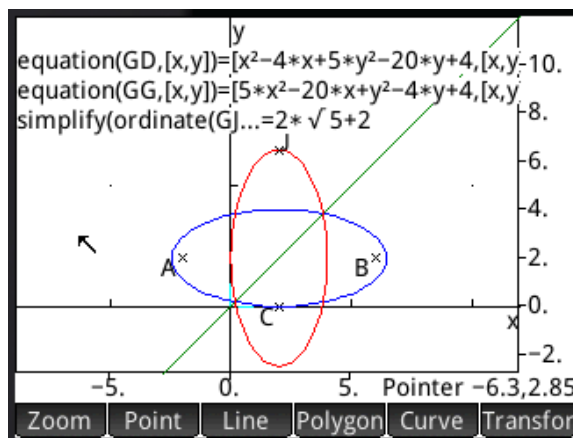
This one construction can now help your students visualize the derivative of any function!

Save this construction with a name you'll remember and use the Geometry App to make other constructions.

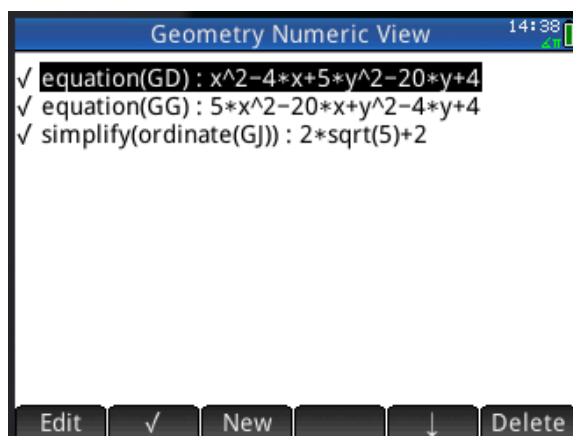


In this construction, we have a blue ellipse defined by the focal points A and B, and a point C on the ellipse.

The red ellipse is the reflection of the blue one over the line  $y=x$ . They are inverses of each other. Note the equations of the two ellipses and how the roles of  $x$  and  $y$  are interchanged. Since the points A, B, and C were defined exactly in the Symbolic view, the equations are exact as well. Also, the  $y$ -coordinate of point J is shown to emphasize the exact nature of the result.

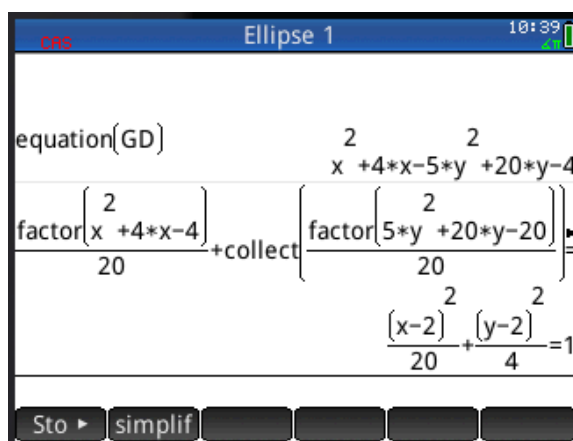


The Numeric view of the Geometry app is where you go to make measurements or create calculations based on measurements. Check the ones you want displayed in the Plot view.



Here the CAS is used to retrieve the equation of the blue ellipse and put it into a more familiar form.

Note the length of the major semi-axis is  $\sqrt{20} = 2\sqrt{5}$  and the center is at (2,2). So the point J on the reflected ellipse should have a  $y$ -coordinate of  $2 + 2\sqrt{5}$ , which it does exactly as shown in the figure above.



The integration of the CAS and dynamic geometry gives you an exact analytical geometry app that is dynamic as well.

### The Spreadsheet App

The Spreadsheet App gives you the most common features you expect in a spreadsheet. But with HP Prime, you also get the power of a CAS integrated with the spreadsheet.

You can define the entire spreadsheet with a single command. Here we produced Pascal's Triangle using just the nCr command (COMB) and the Row and Col variables.

Or how about a handy reference table of the first thousand or so Pythagorean triplets? It's easy!

Here we used the CAS to define one column of the spreadsheet to expand the binomial  $x+1$  to various integer powers. Note the expression editor shows a CAS button. When active, the CAS is used to evaluate the expression. When it is not active, expressions are evaluated to numerical results, as in the previous examples. Imagine all the patterns you and your students can explore in symbolic expressions!

The Spreadsheet App can also handle commands with multiple outputs, such as summary statistics. Here, the AMORT command was used to display an amortization table for a 30-year, \$500,000 loan at 5% interest with monthly payments of \$2684.11.

| %  | A | B          | C          | D          | E      |
|----|---|------------|------------|------------|--------|
| 1  | 1 | Error: Inv | Error: Inv | Error: Inv | Error: |
| 2  | 1 | 1          | Error: Inv | Error: Inv | Error: |
| 3  | 1 | 2          | 1          | Error: Inv | Error: |
| 4  | 1 | 3          | 3          | 1          | Error: |
| 5  | 1 | 4          | 6          | 4          | 1      |
| 6  | 1 | 5          | 10         | 10         | 5      |
| 7  | 1 | 6          | 15         | 20         | 15     |
| 8  | 1 | 7          | 21         | 35         | 35     |
| 9  | 1 | 8          | 28         | 56         | 70     |
| 10 | 1 | 9          | 36         | 84         | 126    |
| 11 | 1 | 10         | 45         | 120        | 210    |

=COMB{Row-1,Col-1}

Name CAS [ ] [ ] Cancel OK

| %  | A  | B   | C   | D | E |
|----|----|-----|-----|---|---|
| 1  | 3  | 4   | 5   |   |   |
| 2  | 5  | 12  | 13  |   |   |
| 3  | 7  | 24  | 25  |   |   |
| 4  | 9  | 40  | 41  |   |   |
| 5  | 11 | 60  | 61  |   |   |
| 6  | 13 | 84  | 85  |   |   |
| 7  | 15 | 112 | 113 |   |   |
| 8  | 17 | 144 | 145 |   |   |
| 9  | 19 | 180 | 181 |   |   |
| 10 | 21 | 220 | 221 |   |   |
| 11 | 23 | 264 | 265 |   |   |

Edit Format Go To Select Go ↓ [ ]

| % | A                               | B |
|---|---------------------------------|---|
| 1 | $x+1$                           |   |
| 2 | $x^2+2*x+1$                     |   |
| 3 | $x^3+3*x^2+3*x+1$               |   |
| 4 | $x^4+4*x^3+6*x^2+4*x+1$         |   |
| 5 | $x^5+5*x^4+10*x^3+10*x^2+5*x+1$ |   |

=simplify( expand( (x+1)<sup>Row</sup> ) )

Name CAS\* [ ] [ ] Cancel OK

| %  | A      | B     | C   | D         | E         | F         |
|----|--------|-------|-----|-----------|-----------|-----------|
| 1  | Amorti |       |     |           |           |           |
| 2  |        | Start | End | Balance   | Principal | Interest  |
| 3  | Period | 1     | 12  | 492623.15 | -7376.84  | -24832.47 |
| 4  | Period | 13    | 24  | 484868.88 | -7754.26  | -24455.05 |
| 5  | Period | 25    | 36  | 476717.90 | -8150.98  | -24058.33 |
| 6  | Period | 37    | 48  | 468149.89 | -8568.00  | -23641.31 |
| 7  | Period | 49    | 60  | 459143.53 | -9006.36  | -23202.95 |
| 8  | Period | 61    | 72  | 449676.38 | -9467.14  | -22742.17 |
| 9  | Period | 73    | 84  | 439724.88 | -9951.50  | -22257.81 |
| 10 | Period | 85    | 96  | 429264.24 | -10460.6  | -21748.68 |
| 11 | Period | 97    | 108 | 418268.42 | -10995.8  | -21213.49 |

=AMORT(A2,"",360,5,500000,-2684.11)

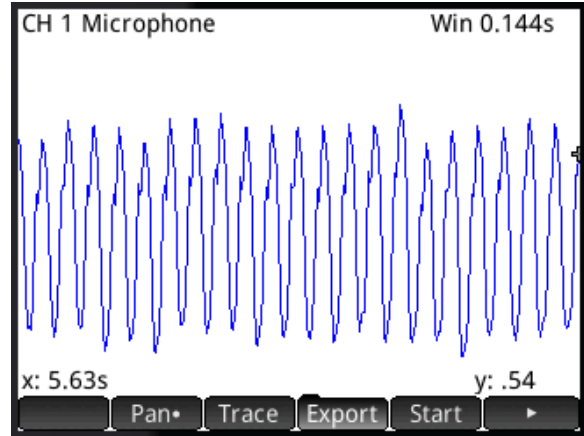
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### The Data Streamer App

The Data Streamer App works with the HP StreamSmart 410 and up to four Fourier<sup>®</sup> sensors to collect data in real time. The final data set is sent to one of the statistics apps for analysis.

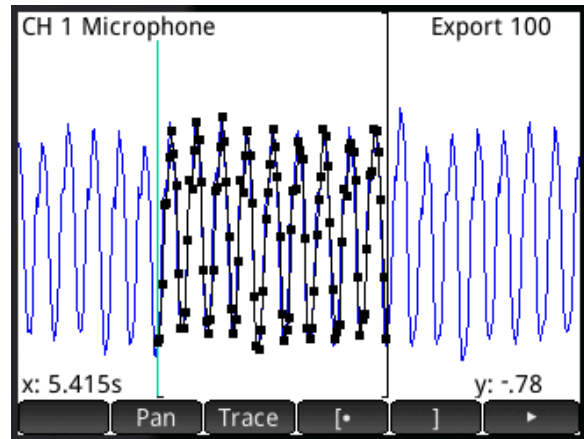
Just plug the microphone sensor into the StreamSmart 410 and start the Data Streamer App. The microphone is automatically identified. Just tap **Start** to see your own voice in real time. Zoom in/out while data is still streaming.

Here, all the data you see was collected in 0.144 seconds-roughly 1/7 of a second!



Tap **Export** to select a final data set. You can crop data from the left and right, as well as thin your data set to get just the data you want.

Once you have selected a final data set, send your data to one of the Statistics Apps for analysis.



Here we see the same data numerically in the Numeric view of the Statistics 2Var App. From here, you can make a scatter plot of the data and create a trigonometric fit.

|    | C1     | C2      | C3 | C4 |
|----|--------|---------|----|----|
| 1  | 5.4153 | -0.7555 |    |    |
| 2  | 5.4162 | -0.365  |    |    |
| 3  | 5.4166 | 0.1965  |    |    |
| 4  | 5.4171 | 0.2112  |    |    |
| 5  | 5.418  | 0.5419  |    |    |
| 6  | 5.4184 | 0.725   |    |    |
| 7  | 5.4189 | 0.5712  |    |    |
| 8  | 5.4198 | 0.3381  |    |    |
| 9  | 5.4202 | -0.2868 |    |    |
| 10 | 5.4207 | -0.6835 |    |    |
| 11 | 5.4216 | -0.686  |    |    |
| 12 | 5.4221 | -0.5737 |    |    |
| 13 | 5.4225 | -0.0513 |    |    |
| 14 | 5.423  | 0.3808  |    |    |
| 15 | 5.4239 | 0.3137  |    |    |

5.4153

Buttons: Edit, Ins, Sort, Size, Make, Stats



## Examination Mode

HP Prime can be configured and locked for an examination. The machine will remain locked for the pre-set time period and secured with a password. LED lights at the top of the unit will flash to show that it is in examination mode.

Go to the Exam Mode interface, give your configuration a name, set a time period, and give it a password. You can also check a box to erase memory when examination mode starts, and check another box to make the LED lights blink while in examination mode.

Tap **Config** to select the features you want to disable.

Here we have disabled all saved apps, the whole CAS, and new notes and user programs.

You can block individual apps, all matrix operations, units, even the Help system.

In the Mathematics menu, you can disable commands by category or individually.

Create as many custom configurations as you like and save them with names you will remember. You can edit any saved configuration as well. Start the examination mode on the HP Prime or send it to another HP Prime via USB. Once examination mode has started, the LED lights will blink to show that the configuration is in effect.

