TI-Nspire™ CX II Handhelds Guidebook

TI-Nspire™ CX II

TI-Nspire™ CX II CAS

Learn more about TI Technology through the online help at education.ti.com/eguide.

Important Information

Except as otherwise expressly stated in the License that accompanies a program, Texas Instruments makes no warranty, either express or implied, including but not limited to any implied warranties of merchantability and fitness for a particular purpose, regarding any programs or book materials and makes such materials available solely on an "as-is" basis. In no event shall Texas Instruments be liable to anyone for special, collateral, incidental, or consequential damages in connection with or arising out of the purchase or use of these materials, and the sole and exclusive liability of Texas Instruments, regardless of the form of action, shall not exceed the amount set forth in the license for the program. Moreover, Texas Instruments shall not be liable for any claim of any kind whatsoever against the use of these materials by any other party.

TI-Nspire™ CX II License Agreement: education.ti.com/license

TI-Nspire™ CX II Warranty: education.ti.com/warranty

Limited Warranty. This warranty does not affect your statutory rights.

Vernier DataQuest™ is a trademark of its respective owner.

Actual products may vary slightly from provided images.

TI-Nspire™ CX II Handhelds: TI-Nspire™ CX II, TI-Nspire™ CX II CAS, TI-Nspire™ CX II-T, TI-Nspire™ CX II-T CAS, TI-Nspire™ CX II-C CAS, and TI-Nspire™ CX II EZ-Spot

Contents

Getting Started with TI-Nspire™ CX II Handhelds

The TI-Nspire™ CX II and the TI-Nspire™ CX II CAS are the newest handhelds in the TI-Nspire™ family of products. Featuring a backlit color display and a slimmer form, the handhelds provide touchpad navigation, dynamic graphing, and interactive computer features.

The handhelds and the TI-Nspire™ software share the same functionality, enabling you to transfer class assignments from the handheld to the computer or transfer documents to the handheld when you need to be mobile. Start assignments at school, and then finish the work at home to take advantage of the software's full-color display and easy-to-use navigation. Use the software to download the latest software and handheld operating system updates as they become available to ensure you have the latest enhancements.

This guide covers the following TI-Nspire™ CX II handhelds:

- TI-Nspire™ CX II / TI-Nspire™ CX II CAS
- TI-Nspire™ CX II-T / TI-Nspire™ CX II-T CAS
- TI-Nspire™ CX II-C CAS
- TI-Nspire™ CX II EZ-Spot

While they operate identically in many ways, there are a few distinctions. If there are differences between the Numeric, Exact Arithmetic, or CAS handhelds, it is pointed out and the appropriate operation is described.

About Math Modes

TI-Nspire CX II handhelds perform calculations in one of three modes: Numeric, Exact Arithmetic, or Computer Algebra System (CAS).

Numeric mode supports results in terms of floating point numbers, integers, and stacked fractions only.

Exact Arithmetic mode supports results in terms of floating point numbers, integers, stacked fractions, π, e, radicals $\sqrt{}$, and other constants such as ln(5) and sin(2).

CAS mode supports the same results as Exact Arithmetic as well as symbol manipulation such as x+x, and CAS functions such as symbolic factoring, solving equations, limits, and indefinite integration.

The math modes that are available will depend on which TI-Nspire CX II handheld model you have:

Handheld Model	Numeric	Exact Arithmetic	CAS
TI-Nspire CX II	✓		
TI-Nspire CX II CAS	✓ [1]	✓	✓

Handheld Model	Numeric	Exact Arithmetic	CAS
TI-Nspire CX II-T	✓ [2]	✓	
TI-Nspire CX II-T CAS	✓ [1]	✓	✓
TI-Nspire CX II-C CAS	✓ [1]	✓	✓

[1] CAS mode turned off

[2] Exact Arithmetic mode turned off

TI-Nspire™ CX II Handheld Keys

Use the TI-Nspire™ Touchpad as you would a laptop touchpad. You can also press the outer edges to move right, left, up, and down.

esc Removes menus or dialog boxes from the screen. Also stops a calculation in progress.

Opens the Scratchpad for performing quick calculations and graphing.

tab Moves to the next entry field.

⇧shift Makes the next character typed upper-case.

ctrl Provides access to the function or character shown above each key. Also enables shortcuts in combination with other keys.

on Turns on the handheld. If the handheld is on, this key displays the home screen.

doc Opens the Document menu.

menu Displays the application or context menu.

del Deletes the previous character.

var Displays stored variables.

enter Evaluates an expression, executes an instruction, or selects a menu item.

Note: A ▸ symbol on a key indicates access to multiple options. To access an option, press ?! repeatedly or use the arrow keys on the Touchpad. Press enter or click to select the option.

Preparing the TI-Nspire™ CX II Handheld for Use

The TI-Nspire™ CX II handheld comes equipped with a Li-ion rechargeable battery. The handheld also comes with the following accessories:

- Standard mini-A to mini-B USB cable for transferring files to another handheld
- Standard A to mini-B USB cable for transferring files to and from a computer and for charging the battery

Charging the Handheld

▶ Using one of the following options, charge the battery for at least four hours to ensure optimum performance.

- Connect the handheld to a computer using a standard A to mini-B USB cable. To download software that includes a driver, go to education.ti.com/software.
- Connect to a wall outlet using a TI wall adapter (sold separately).
- If in a classroom setting, place the handheld or multiple handhelds in a TI-Nspire™ CX Docking Station or a TI-Nspire™ Docking Station.

Note: The TI-Nspire™ CX II handheld has a Deep Sleep feature to maximize battery life during extended storage periods. To put the handheld in Deep Sleep mode, press and hold down the blue reset button on the back of the handheld for at least 4 seconds. To wake the handheld from Deep Sleep mode, press [on] for at least 4 seconds or apply USB (computer or wall adapter) or Docking Station power. After waking the handheld, you can turn it on anytime by pressing [on].

Note: For more information about recharging batteries, see *Configuring TI-Nspire™ Handhelds*.

Turning On the TI-Nspire™ CX II Handheld for the First Time

After charging the battery, press [on] to turn on the handheld. A progress bar is displayed while the operating system loads. Next, choose preferences for language and font size when prompted.

Note: To turn the handheld off, press [ctrl] [on]. The settings and memory contents are retained.

Using Automatic Power Down™

To prolong battery life, the Automatic Power Down™ (APD™) feature turns off the handheld after three minutes of inactivity. When this happens, press [on] to turn the handheld on and return to the last document or last menu accessed. To change the default setting, press [on] [5] [3] to access the **Handheld Setup** screen where you can change the **Power Standby** setting.

Note: For more information about setting up the handheld, see *Configuring Handhelds*.

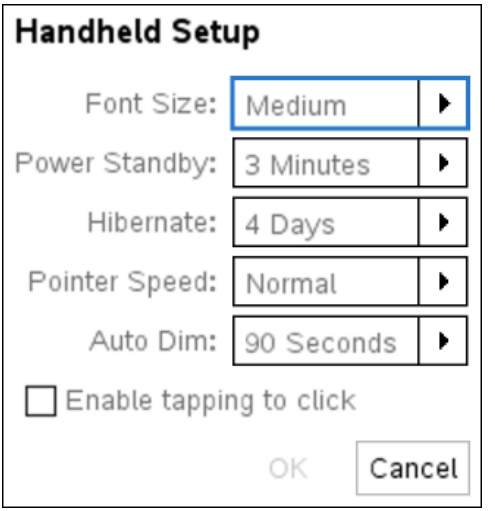
Choosing a Language

After the OS is loaded, select a preferred language.

1. Press ▶ to open the drop-down list.
2. Press ▼ to scroll through the languages, and then press ☜ or enter to select a language.
3. Press tab to highlight the **OK** button, and then press ☜ or enter to save the language selection.

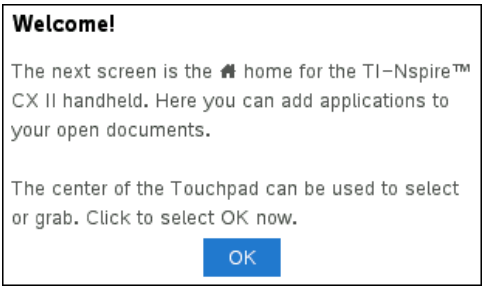
Choosing a Font Size

Next, select a font size for the display.



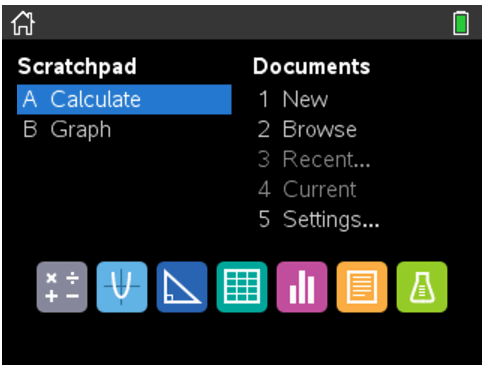
1. Press ▶ to open the drop-down list.
2. Press ▼ to highlight the font size, and then press ☜ or enter to select it.
3. Press tab to highlight the **OK** button, and then press ☜ or enter.

   The **Welcome!** screen opens.



4. To continue, press [touchpad] or [enter] to select **OK**.

   The **Home** screen opens.



Adjusting the Brightness of the Backlighting

The screen on the TI-Nspire™ CX II handheld is backlit making it easier to use in all lighting conditions. By default, the brightness setting is medium. To adjust the backlight brightness:

- **Dimmer:** Press and hold [ctrl] and tap [−].
- **Brighter:** Press [ctrl] and tap [+].

Using the TI-Nspire™ Touchpad

Use the Touchpad to navigate or complete any task that can be completed using the arrow and **Enter** keys. Use the Touchpad to navigate in two ways:

- Use it like a computer touchpad by moving your fingertip in a sliding motion on the center area of the Touchpad to activate and move the mouse pointer. Click or tap the center of the Touchpad to select a menu option or complete an action.

- Press the arrow keys on the outside edge of the Touchpad to nudge the mouse pointer up, down, left, or right, and then click tab or press enter to complete an action.

  If you hold down an arrow key, the mouse pointer continues to move in that direction.

Note: If the mouse pointer is visible on a command or file, click or tap in the center of the Touchpad to select that command or file. If the command or file is highlighted, move the pointer over that item or press enter to select it.

When working in an application, use the Touchpad to access more information about problems. For example, hovering over a Graphs & Geometry object displays information about variables used in that object and about tools that are available.

Some users prefer to customize their Touchpad settings; to speed up or slow down their pointer, or to enable tap to click. To change the default settings for the Touchpad, see *Configuring Handhelds*.

Understanding the Scratchpad

Use the Scratchpad to make quick calculations and graphs without affecting the current TI-Nspire™ document. For example, when you need a quick way to test a calculation before you add it to a document, you can open the Scratchpad application and perform the calculation. Then, you can either discard the calculation or add it to a document. For more information about the Scratchpad, see *Using the Scratchpad*.

Using the Home Screen

The **Home** screen provides a starting point for all activities performed on a handheld:

- Opening the scratchpad for quick calculations and graphing
- Creating new documents
- Opening and managing existing documents
- Defining settings and viewing status
- Viewing hints for operating the handheld
- Accessing recent documents
- Returning to the current document

Note: Press on to toggle between the **Home** screen and the current document.

Home Screen Options

Menu Option	Purpose
Scratchpad Use the Scratchpad menu options to open a Calculator or Graph application without affecting your document.	

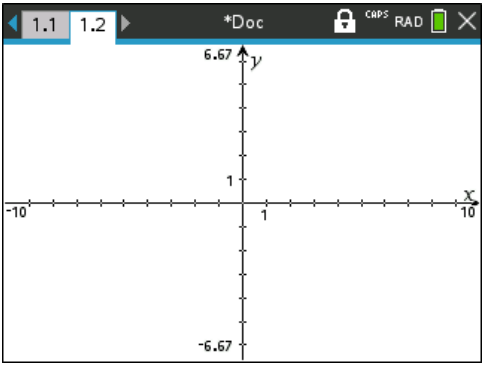
Menu Option	Purpose
While in Scratchpad, press [⊞] to toggle between Scratchpad applications: Calculate and Graph.	
Calculate	Opens the Scratchpad with a Calculator application active. From the Home screen, type [A].
Graph	Opens the Scratchpad with a Graph application active. From the Home screen, type [B].
Documents To select options for working with documents, press the associated number or use the Touchpad to select an icon then press [⊙] or [enter].	
New	Opens a new TI-Nspire™ document with available applications listed.
Browse	Opens the file browser where you can open existing TI-Nspire™ documents or send files to others.
Recent	Lists the five most recently saved documents.
Current	Goes to the document that is currently open.
Settings	Check the status of the handheld and change settings.
Application icons To add a new page to the current document, select an application icon. If no document is open, a new document opens with the selected application on a new page.	
Calculator 	Adds a page to a document for entering and evaluating math expressions.
Graphs 	Adds a page for graphing and exploring functions.
Geometry 	Adds a page for creating and exploring geometric shapes.
Lists & Spreadsheet 	Adds a page for working with data in tables.

Menu Option	Purpose
Data & Statistics	Adds a page and provides tools used to visualize sets of data in different types of plots and provides tools for manipulating data sets to explore relationships between the sets of data.
Notes	Provides text editing functions for adding text to TI-Nspire™ documents for use as notes or to share with other users.
Vernier DataQuest™	Adds a page for collecting and analyzing data from sensors or probes.

To learn more about applications and documents, see *Working with Documents on TI-Nspire™ Handhelds*.

The TI-Nspire™ CX II Handheld Screen

When you are working in a document on a handheld, icons at the top of the screen provide information about the status of handheld operations and provide an easy way to change settings. The icons are described below.



Icon	Function
◀▶	**Page scrolling arrows** - Use the touchpad to click these arrows and scroll through the pages in a document.
1.1	**Page tab** - Labels the problem number and page number of the active page. For example, a label of **1.2** identifies Problem **1**, Page **2**. If problems are named, hover the pointer over a tab to view the page name.
***Doc**	**Document name** - Shows the current document name. An asterisk by the document name indicates changes were made since the document was last

Icon	Function
	saved. Click the name to open the **Documents** menu.
	**Press to Test** - Indicates that the handheld is in Press-to-Test mode.
	**Login status** - Shows whether the handheld is searching for an access point (blinking), found an access point (solid), not communicating, connected and ready to log in (a blinking arrow), or logged in and charged (a solid arrow). Click here to view Settings & Status.
CAPS	Shows status of the shift, ctrl, and CAPS keys.
RAD	**Angle Mode** - Shows an abbreviation of the angle mode (Degrees, Radians, or Gradians) in effect. Hover the pointer over the indicator to see the full name. **Note:** Click the indicator to toggle between RAD and DEG modes.
	**Settings & Status** - Shows an indicator of the current charge level of the battery. Hover the pointer over the indicator to read the status as a percent. Click the icon to open the **Settings & Status** menu.
	**Close document** - Click the icon to close the current document. If information is unsaved, save or discard when prompted.

Using Hints

Hints are quick tips available throughout the software on the handheld. There are several easy ways to access Hints:

- Press ctrl trig.
- Some dialog boxes contain a question mark icon. Click this icon to open Hints for that task.

To scroll through the Hints, use the Touchpad or arrow keys:

- To page down, press ctrl 3.
- To page up, press ctrl 9.
- To go to the end of the Hints file, press ctrl 1.
- To go back to the beginning of the file, press ctrl 7.

Using Keyboard Shortcuts

Use the following keyboard shortcuts to perform common functions. You can also perform all functions by selecting the options from menus.

Getting Help	
Open Hints	ctrl trig
Editing Text	
Cut	ctrl X
Copy	ctrl C
Paste	ctrl V
Undo	ctrl Z ctrl esc
Redo	ctrl Y shift esc
Toggle approximate and exact results **Python Editor and Shell:** Add a new line after the current line.	ctrl enter
English: Change key to include appropriate accent Chinese: Insert character	
Inserting Characters and Symbols in a document	
Display character/symbol palette	ctrl
Underscore	ctrl ␣
Display math template palette	
Backslash (\ )	shift ÷
Manual data capture point	ctrl .
Clear	ctrl del
Caps Lock	ctrl shift
Store	ctrl var

Square brackets	ctrl (
Curly brackets	ctrl)
Display Trig symbol palette	trig
Equals symbol	=
Display pi symbols palette (π, ⁄, θ, and so on)	π
Display equality/inequality palette (>, <, ≠, ≤, ≥, and |)	ctrl =
Display marks and letter symbols palette (? ! $ ° ' % " : ; _ \)	?!
Square root	ctrl x^2
log	ctrl 10^x
ln	ctrl e^x
ans	ctrl (–)
Managing Documents	
Open document menu	doc
Open document	ctrl O
Close document	ctrl W
Create new document	ctrl N
Insert new page	ctrl I
Select application	ctrl K
Save current document	ctrl S ctrl
Navigation	

Top of page **Python Editor and Shell:** Moves cursor to the beginning of the first line in the program.	ctrl 7
End of page **Python Editor and Shell:** Moves cursor to the end of the last line in the program.	ctrl 1
Page Up	ctrl 9
Page Down	ctrl 3
Up a level in the hierarchy	ctrl ▲
Down a level in the hierarchy	ctrl ▼
Context menu for selection	menu
Extends selection in direction of arrow	⇧shift Any arrow
Python Editor and Shell: Indents text on the current line or selected lines or navigates between inline prompts	tab
Navigating in Documents	
Displays previous page	ctrl ◀
Displays next page	ctrl ▶
Displays Page Sorter	ctrl ▲
Exits Page Sorter	ctrl ▼
Switch between applications on a split page	ctrl tab
Moves focus backward within page **Python Editor and Shell:** Dedents text on the current line or selected lines or navigates backwards between inline prompts	⇧shift tab

Wizards and Templates	
Add a column to a matrix after the current column	shift ↵
Add a row to a matrix after the current row **Python Editor and Shell:** Add a new line after the current line.	↵
Integration template	shift +
Derivative template	shift −
Math template palette	⌨ or ctrl ⚐
Fraction template	ctrl ÷
Modifying Display	
Increase contrast	ctrl +
Decrease contrast	ctrl −
Power off	ctrl on
Application-Specific Shortcuts	
Notes/Program Editor/Python Editor: Select all **Press-to-Test:** Select all items in the dialog	ctrl A
Program Editor/Python Editor: Check syntax and store	ctrl B
Program Editor/Python Editor: Find	ctrl F
Geometry/Graph: Hide/Show Entry Line **Lists & Spreadsheet/Program Editor/Python Editor:** Go To	ctrl G
Program Editor/Python Editor: Find and Replace	ctrl H
Calculator/Program Editor/Python Editor and Shell: Beginning of line	ctrl 8

Calculator/Program Editor/Python Editor and Shell: End of line	ctrl 2
Notes: Insert math expression box	ctrl M
Notes: Insert chemical equation box	ctrl E
Open the Scratchpad	
Lists & Spreadsheet: Recalculate **Program Editor:** Check syntax, store program and paste program name in Calculator (after clearing current line in Calculator) **Python Editor:** Check syntax, save program and execute in Python Shell **Python Shell:** Rerun last program	ctrl R
Geometry/Graphs/Lists & Spreadsheet: Add Function Table **Program Editor/Python Editor and Shell:** Add/remove comment symbol	ctrl T
Group/Ungroup applications on a page	ctrl 4 / ctrl 6

Using the Scratchpad

The Scratchpad is a feature of the TI-Nspire™ CX handheld that lets you quickly:

- Evaluate math expressions.
- Graph functions.

Opening and Closing the Scratchpad

▶ From the Home screen, press [ ] to open the Scratchpad.

The first time you open the Scratchpad, a blank page opens with the Calculator active.

▶ Press [ ] to alternate between the Calculate and Graph pages.

▶ Press [menu] to see the Scratchpad Calculate or Scratchpad Graph menu. These menus are subsets of the TI-Nspire™ menus for the Calculator and Graphs applications. For complete listings of those menus, see the documentation for those applications.

▶ Press [esc] to close the Scratchpad.

Calculating with Scratchpad

From the Scratchpad Calculate page, enter a math expression on the entry line, and then press [enter] to evaluate the expression. Expressions are displayed in standard mathematical notation as you enter them.

Each evaluated expression and result becomes part of the Scratchpad history, displayed above the entry line.

Entering Simple Math Expressions

Note: To enter a negative number, press [(-)] and then type the number.

Suppose you want to evaluate $\frac{2^8 \cdot 43}{12}$

1. Select the entry line in the work area.
2. Type **2** [^] **8** to begin the expression.

3. Press [▶] to return the cursor to the baseline, and then complete the expression by typing:
   [×] **43** [÷] **12**

4. Press enter to evaluate the expression.

   The expression is displayed in standard mathematical notation, and the result is displayed on the right side of the page.

$$\frac{2^8 \cdot 43}{12} \qquad \frac{2752}{3}$$

   Note: You can force a decimal approximation in a result by pressing ctrl enter instead of enter.

Pressing ctrl enter forces the approximate result.

Note: Results formatting can also be adjusted in settings. For more information about customizing settings, see *Configuring Handhelds*.

Inserting Items from the Catalog

You can use the Catalog to insert functions and commands, symbols, and expression templates into the entry line.

1. Press ctrl T to open the Catalog. By default, the first tab is displayed, which lists all commands and functions in alphabetical order.
2. If the function you are inserting is visible in the list, select it and press enter to insert it.
3. If the function is not visible:
   a) Press a letter key to jump to the entries that begin with that letter.
   b) Press ▼ or ▲ as necessary to highlight the item you are inserting.
   c) Click a numbered tab to list functions by category: math functions, symbols, math templates, library objects, and value for standard measurement units.
   d) Press enter to insert the item into the entry line.

Using an Expression Template

Templates help you enter matrices, piecewise functions, systems of equations, integrals, derivatives, products, and other math expressions.

For example, suppose you want to evaluate $\sum_{n=3}^{7}(n)$

1. Press [▦] to open the Template palette.

2. Select  to insert the algebraic sum template.

   The template appears on the entry line with small blocks representing elements that you can enter. A cursor appears next to one of the elements to show that you can type a value for that element.

3. Use the arrow keys to move the cursor to each element's position, and type a value or expression for each element.

4. Press [enter] to evaluate the expression.

Inserting Expressions Using a Wizard

You can use a wizard to simplify entering some expressions. The wizard contains labeled boxes to help you enter the arguments in the expression.

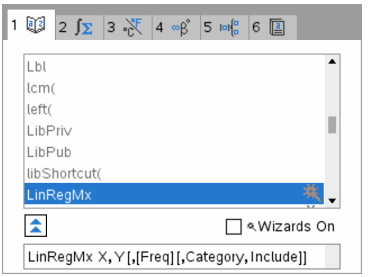
For example, suppose you want to fit a y=mx+b linear regression model to the following two lists:

{1,2,3,4,5}
{5,8,11,14,17}

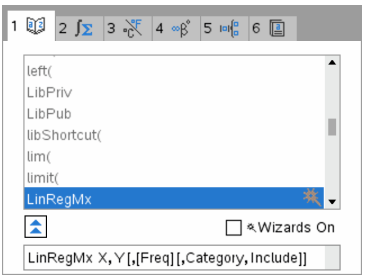
1. Press [📖] [1] to open the Catalog and show the alphabetic list of functions.

2. Click inside the list, and then press [L] to jump to the entries that begin with "L."

3. Press ▼ as necessary to highlight **LinRegMx**.
4. If the **Wizards On** option is not checked, press tab tab to highlight **Wizards On**.
5. Press enter to change the setting.
6. Press tab tab to highlight **LinRegMx** again.



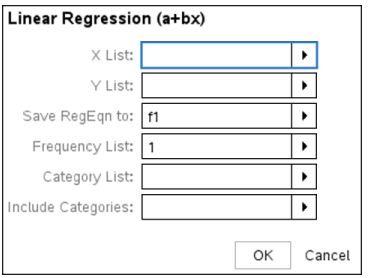
LinRegMx function in a non-CAS or Exact Arithmetic handheld



LinRegMx function in a CAS handheld

7. Press enter.

   A wizard opens, giving you a labeled box to type each argument.



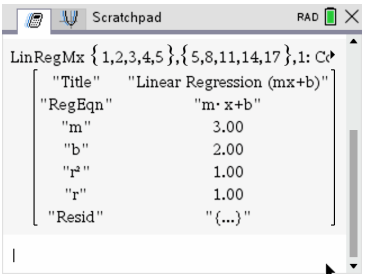
8. Type {**1**,**2**,**3**,**4**,**5**} as **X List**.
9. Press tab to move to the **Y List** field.
10. Type **{5,8,11,14,17}** as **Y List**.

11. If you want to store the regression equation in a specific variable, press tab, and then replace **Save RegEqn To** with the name of the function variable (f1 through f99).
12. Click **OK** to close the wizard and insert the expression into the entry line.

    The expression is inserted along with statements to copy the regression equation and display the variable *stat.results*, which will contain the results.

    LinRegMx {1,2,3,4,5},{5,8,11,14,17},1: CopyVar stat.RegEqn,f1: stat.results

    The Scratchpad then displays the *stat.results* variables.

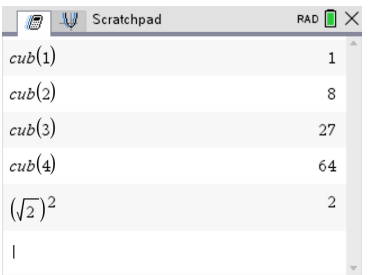


    Note: You can copy values from the *stat.results* variables and paste them into the entry line.

Viewing the History

Each evaluated expression and result becomes part of the Scratchpad history, displayed above the entry line.

▶ Press ▲ or ▼ to scroll through the history.



Copying a History Item to the Entry Line

You can quickly copy an expression, subexpression, or result from the history into the entry line.

1. Press ▲ or ▼ to move through the history and select the item that you want to copy.

2. Optionally, select part of the expression or result by using shift in combination with the arrow keys.

3. Press enter to copy the selection and insert it into the entry line.

Clearing the History

When you clear the history, all variables and functions defined in the history retain their current values. If you clear the history by mistake, use the undo feature.

▶ From the **Actions** menu, click **Clear History**.

—or—

Press menu 1 5.

All expressions and results are removed from the history.

Editing Scratchpad Expressions

Although you cannot edit a Scratchpad Calculate expression in the history, you can copy all or part of an expression from the history and paste it to the entry line. You can then edit the entry line.

Inserting Elements into the Entry Line

1. Press tab, ◀, ▶, ▲, or ▼ to position the cursor in the expression.

   The cursor moves to the closest valid position in the direction that you press.

2. Type the elements or insert them from the Catalog.

Selecting Part of an Expression

You can delete, cut, or copy a selected part of an expression.

1. Press ◀, ▶, ▲, or ▼ to move the cursor to a starting point in the expression.
2. Press and hold shift and press ◀, ▶, ▲, or ▼ to select.
   - To delete the selection, press del.
   - To cut the selection to the Clipboard, press ctrl X.
   - To copy the selection to the Clipboard, press ctrl C.

- To paste the selection to a new entry line in Scratchpad, press ctrl V.

Graphing with the Scratchpad

1. Press [icon] to open the Scratchpad Graph page if it is not already open.

   By default, the entry line is displayed. The entry line displays the required format for typing a relation. The default graph type is Function, so the form *f1*(*x*)= is displayed.

   If the entry line is not shown, press **Ctrl + G** or press menu 2 3 to display the entry line and type an expression to graph.

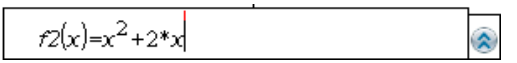
2. Press menu > **Graph Entry/Edit** and select a graph type.

   For example:

   - To graph an equation for a circle, press menu **> Graph Entry/Edit > Equation > Circle > (x-h)^2 + (y-k)^2 = r^2** or press menu 3 2 3 1. Fill in the equation and press enter to draw the circle.
   - To graph a function, press menu **> Graph Entry/Edit > Function** or press menu 3 1.

   The entry line changes to display the expression format for the specified graph type. You can specify multiple relations of each graph type.

3. Type an expression and any other parameters required for the graph type.

4. Press enter to graph the relation, or press ▼ to add another relation. If necessary, you can use press menu 4 to choose a tool on the **Window/Zoom** menu and adjust the viewing area.

   When you graph the relation, the entry line disappears to show an uncluttered view of the graph. If you select or trace a plot, the relation that defines the plot is displayed on the entry line. You can modify a plot by defining a relation or by selecting and changing the graph.

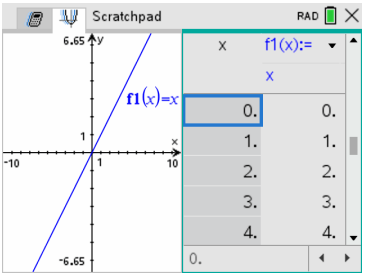
   As you graph multiple plots, the defining relation is displayed for each. You can define and graph a maximum of 99 relations of each type.

5. Use the menu key to explore and analyze the relation to:

   - Trace the relation.
   - Find points of interest.
   - Assign a variable in the expression to a slider.

Viewing the Table

- To display a table of values corresponding to the current plots, press menu > **Table** > **Split-screen Table** (menu 7 1).



- To hide the table, click the graph side of the split screen, and then press menu > **Table** > **Remove Table** (menu 7 2). You can also press **Ctrl + T**.
- To resize columns, click the table and press menu > **Actions** > **Resize** (menu 1 1).
- To delete a column, edit an expression, or edit table settings, click the table and press menu > **Table** (menu 2).

Changing the Appearance of the Axes

As you work with graphs, the Cartesian axes are displayed by default. You can change the appearance of the axes in the following ways:

1. Press menu 4 and choose the Zoom tool to use.
2. Select the axes and press ctrl menu 2 to activate the **Attributes** tool.
   a) Press ▲ or ▼ to move to the attribute to change. For example, choose the end style attribute.
   b) Press ◀ or ▶ to choose the style to apply.
   c) Change any other attributes of the axes as required for your work, and then press enter to exit the attributes tool.
3. Adjust the axes scale and tic mark spacing manually.
   a) Click and hold one tick mark, and move it on the axis. The spacing and number of tic marks increases (or decreases) on both axes.
   b) To adjust the scale and tic mark spacing on a single axis, press and hold ⇧shift, and then grab and drag a tic mark on that axis.
4. Change axis end values by double-clicking them and typing new values.
5. Adjust the location of the axes. To move the existing axes without resizing or rescaling them, click in and drag an empty region of the screen until the axes are in the desired location.

6. Change the axes' scales by pressing menu > **Window/Zoom > Window Settings** (menu 4 1).

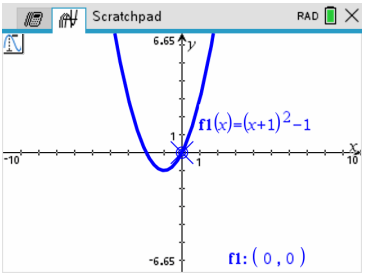
   Type the values of your choice over the current values for x-min, x-max, y-min, y-max, Xscale, and Yscale and click **OK**.

7. Press menu > **View > Hide Axes** (menu 2 1) to hide or show the axes.
   - If the axes are shown on the page, selecting this tool hides them.
   - If the axes are hidden on the page, selecting this tool redisplays them.

Tracing a Plot

Graph Trace moves through the points of a graphed function, parametric, polar, sequence, or scatter plot. To enable the trace tool:

1. Press menu > **Trace > Graph Trace** (menu 5 1) to move across the plot in Trace mode.



2. (Optional) To change the trace step increment for tracing, press menu 5 3.

   After you type a different step increment, the Graph Trace tool moves across the graph in steps of that size.

3. Use Graph Trace to explore a plot in the following ways:
   - Move to a point and hover to move the trace cursor to that point.
   - Press ◀ or ▶ to move from point to point on the function's graph. The coordinates of each point traced are displayed.
   - Press ▲ or ▼ to move from one plot to another. The point's coordinates update to reflect the new location of the trace. The trace cursor is positioned on the point of the new graph or plot with the closest *x* value to the last point identified on the previously traced function or graph.
   - Type a number and press enter to move the trace cursor to the point on the plot with independent coordinates nearest the typed value.
   - Create a persistent point that remains on the graph by pressing enter when the trace point reaches the point you want to label. The point remains after you exit Graph Trace mode.

Notes:

- The string *undef* is displayed instead of a value when you move over a point that is not defined for the function (a discontinuity).
- When you trace beyond the initially visible graph, the screen pans to show the area being traced.

4. Press esc or choose another tool to exit Graph Trace.

Finding Points of Interest

You can use the tools on the **Analyze Graph** menu to find a point of interest in a specified range of any graphed function. Choose a tool to find zero, the minimum or maximum, the point of intersection or inflection, or the numeric derivative (dy/dx) or Integral on the graph.

1. Select the point of interest that you want to find on the **Analyze Graph** menu. For example, to find a zero, press menu 6 1.

	non-CAS and Exact Arithmetic	CAS
Zero	menu 6 1	menu 6 1
Minimum	menu 6 2	menu 6 2
Maximum	menu 6 3	menu 6 3
Intersection	menu 6 4	menu 6 4
Inflection	Not applicable	menu 6 5
dy/dx	menu 6 5	menu 6 6
Integral	menu 6 6	menu 6 7
Analyze Conics	menu 6 7	menu 6 8

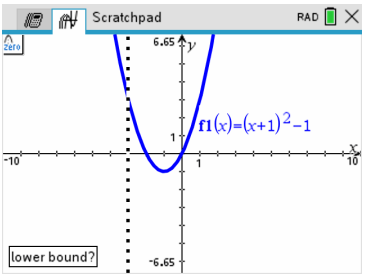
The icon for the selected tool is displayed at the top left on the work area. Point to the icon to view a tooltip about how to use the selected tool.

2. Click the graph you want to search for the point of interest, and then click a second time to indicate where to start the search for the point.

   The second click marks the lower bound of the search region and a dotted line is displayed.

   Note: If you are finding the derivative (dy/dx), click the graph at the point (numeric value) to use for finding the derivative.

3. Press ◀ or ▶ to move the dotted line that marks the search region, and then click the point at which you want to stop the search (upper bound of the search region).



4. Press enter at the point to start the search. The tool shades the range.

   If the search region you specified includes the point of interest, a label for the point is displayed. If you change a graph that has points of interest identified, be sure to check for changes in points of interest. For example, if you edit the function on the entry line or manipulate a plot, the point where the graph intersects zero can change.

   The labeled points of interest remain visible on the graph. You can exit the tool by pressing esc or choosing another tool.

Working with Variables in the Scratchpad

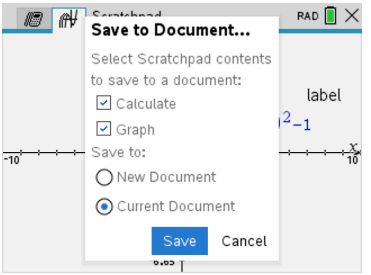
Scratchpad variables are shared between Scratchpad Calculate and Scratchpad Graph, but not with any TI-Nspire™ documents. If you use the same name for a Scratchpad variable and a variable in a document, no conflict occurs unless you attempt to copy expressions between documents and the Scratchpad.

Saving the Scratchpad Contents

You can save the Scratchpad Calculate page, the Scratchpad Graph page, or both as a TI-Nspire™ document.

1. Press doc, and then select **Save to Document** (doc A).
2. Press enter.

   The Save to Document dialog box opens.



3. Select the page or pages to save.
4. If a document is open, select either New or Current document.
5. Click **Save**.
   - If you selected to save to a current (open) document, the Scratchpad pages are added to the document.
   - If you selected to save the Scratchpad pages to a new document, the pages are converted to an unsaved document. To save the document:
     - Press doc▾ **> Save**. The Save As dialog box opens.
     - Type a name for the document.
     - Select **Save** to save the new document.

Clearing Scratchpad Contents

Complete the following steps to delete the calculations and graphing work from the Scratchpad application.

1. Press doc▾ > **Clear Scratchpad** (doc▾ B).
2. Press enter to delete the Scratchpad contents.

Working with Documents on TI-Nspire™ CX II Handhelds

All of the work you do with a TI-Nspire™ CX II handheld is contained in one or more TI-Nspire™ documents, which you can share with other handheld users and with those using the computer software.

- Each document is divided into at least one, and up to 30, problems.
- Each problem contains at least one, and up to 50, pages.
- Each page can be divided into as many as four work areas.
- Each work area can contain any of the TI-Nspire™ applications (Calculator, Graph, Geometry, Lists & Spreadsheet, Data & Statistics, Notes, and Vernier DataQuest™).

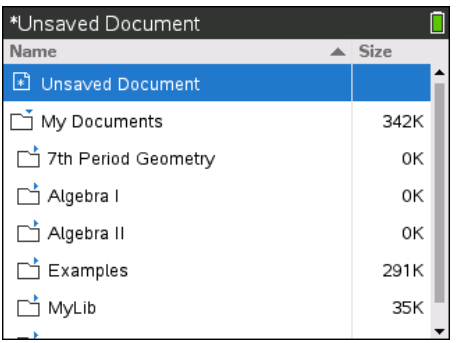
Opening a Document

1. From the Home screen, select Browse.

   —or—

   Press 2.

   The file manager opens.



2. Navigate to the file you want to open.
   - Press ▼ to highlight the document name, and then press ⬚ or enter to open the document.
   - If the file is in a folder, press ▼ to highlight the folder, and then press ⬚ or enter to open the folder.
3. Press doc to open the Documents menu to access options for working with the open document.

Creating a New Document

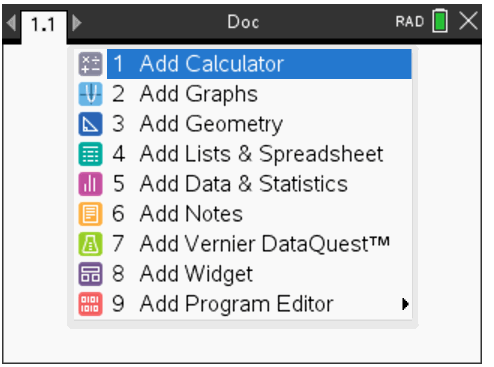
1. From the Home screen, select New.

   —or—

Press 1.

You can also press ctrl N.

A new document opens with a list of applications.



Note: The tab at the top left of the screen indicates that this is the first page of the first problem.

2. Use ▼ and ▲ to highlight the application you want to add to the page, and then press enter to open the page.

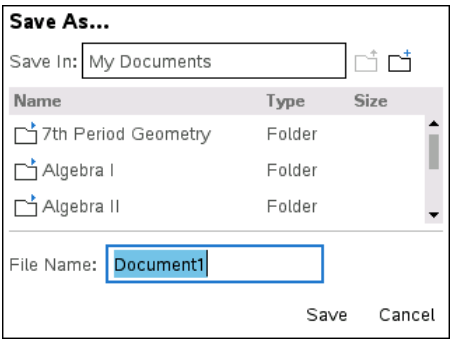
Saving Documents

To save the document in the My Documents folder:

1. Press doc to open the Documents menu, and then select **File > Save**.

   Note: You can also press doc 1 4 or ctrl S to save a document.

   The Save As dialog box opens.



If you are saving the document for the first time, you will be asked which folder to save it to, and what to name the document. The default folder is My Documents.

2. Type a name for the document.
3. Click **Save** to save the document in the My Documents folder.

Saving a Document in a Different Folder

To save the document in a different folder:

1. From an open document, press doc 1 5.

   The Save As dialog box opens.

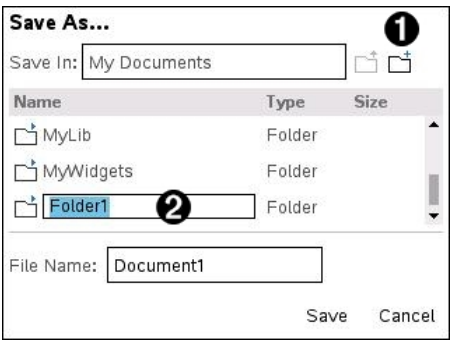
2. Press shift tab to navigate to the list of existing folders. The first folder in the list is selected.
3. Use the ▼ and ▲ to scroll through the list of folders.
4. To select and open a folder, press ctrl.
5. Type a name for the document.
6. Click **Save** to save the document in the selected folder.

Saving a Document in a New Folder

To save the document in a new folder:

1. From an open document, press doc 1 5.

   The Save As dialog box opens.



❶ New folder icon

❷ Type new folder name

2. Press tab until the New Folder icon is highlighted, and then press enter to create a new folder.

   The new folder is added to the bottom of the list of existing folders. By default, the folder name is "Folder1."

3. Type a name for the new folder, and then press enter to save.
4. Press enter again to open the folder.

   The File Name field becomes active.
5. Type a name for the document.
6. Click **Save** to save the document in the new folder.

Working with Applications

Options for working with applications include:

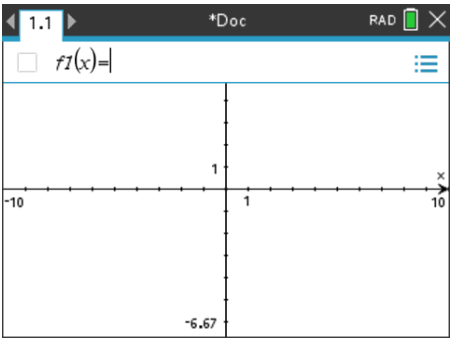
- Creating a new document and selecting an application
- Adding a new page and application to an open document
- Adding multiple applications to a page in a document

Adding an Application

There are multiple ways to add an application to a page:

- When creating a new document, use the Touchpad or corresponding numbers to select an application from the list of applications.
- To add a new page and application to an open document, press ctrl doc and then select an application from the list.

  For example, press 2 to add the Graph application to the page. The application opens in the work area.



You can also press on, and then select an application from the Home screen by clicking one of the following application icons:

	Calculator

	Graphs
	Geometry
	Lists & Spreadsheet
	Data & Statistics
	Notes
	Vernier DataQuest™

Using Multiple Applications on a Page

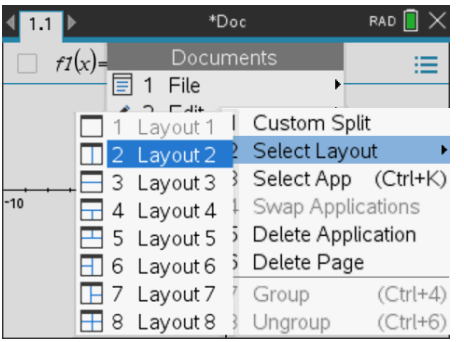
You can add up to four applications to each page.

When you create a new document, it contains space to add one application. If you need to add more than one application to a page, you can change the layout to accommodate as many as four applications.

You can choose a standard layout, provided as a menu item, or you can customize a layout to suit your needs.

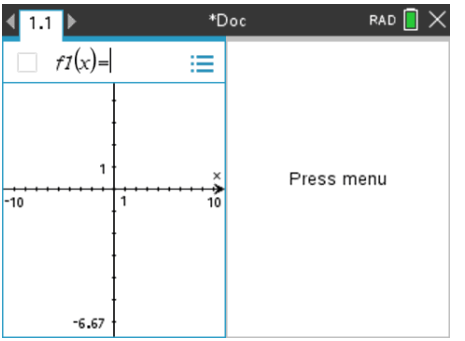
Choosing a Standard Page Layout

1. Press doc▾ 5 2 to display layout options.

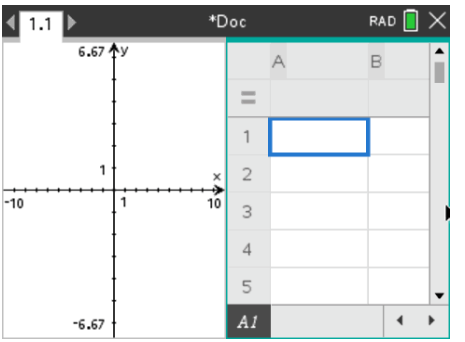


2. Press the number that corresponds to the layout you want.

   For example, press 2 to create a two-pane layout, divided vertically on the page.



3. Press ctrl tab to move between panes. Bold lines around the pane indicate that the pane is active.
4. Press menu, and then press the number of the application you want to add the new pane. For example, press 4 to add the Lists & Spreadsheet application.

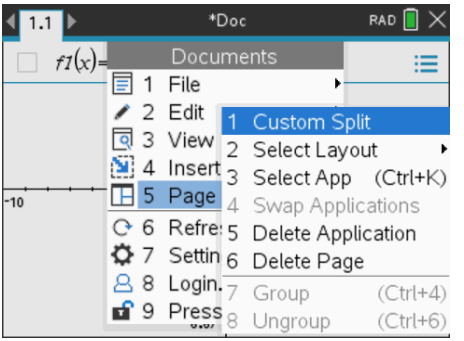


Note: If you need to change the layout of the page to add or delete applications, you can do so at any time. When deleting an application, select the application to be deleted first.

Creating a Custom Page Layout

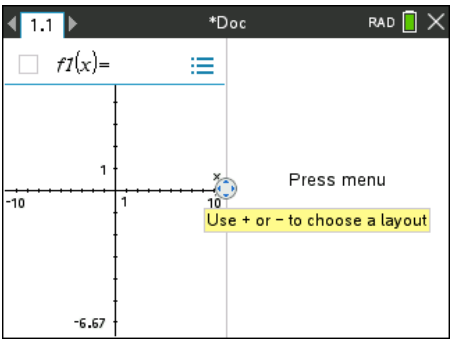
If the standard layouts do not meet your needs, you can customize the space allotted to applications on a page.

1. Press doc 5 to display layout options.



2. Press 1 to select the custom split option.

   The standard layout is displayed with a divider between the application panes. Use the arrows ( ) in the middle of the divider to adjust the size of the panes.



3. Press ▲, ▼, ◀, or ▶ to move the divider to adjust the height or width of the panes in the layout.
4. Press + or − to select a defined layout:
   - Pressing − returns to a full page layout.
   - Pressing + once switches layout from a vertical layout to a horizontal layout. Press − to go back to a vertical layout.
   - Pressing + twice adds a third pane to the page. Pressing + multiple times enables you to choose between a vertical and horizontal page layout with three panes.
   - Pressing + five times adds a fourth pane to the page. Press − to cycle through the previous layout options.
5. Press ctrl or enter to accept the layout dimensions.

6. Press ctrl tab to move between panes. Bold lines around the pane indicate that the pane is active.

Swapping Applications on a Page

If you want to change the position of applications on a page with multiple applications, you can do so by "swapping" the positions of two applications.

1. Press doc 5 Page Layout 4 Swap Application.

   The selected application is surrounded by a heavy, flashing black border, and the Swap App cursor is displayed on the screen.

   Note: On a two-pane page layout, the selected application automatically swaps position with the opposite pane. Press ctrl or enter to complete the swap.

2. Press ▲, ▼, ◀, or ▶ to position the cursor over the application you are targeting to swap.
3. Press ctrl or enter to complete the swap.

   Note: Press esc to cancel the swap.

Grouping Applications

To group up to four application pages into a single page:

1. Select the first page in the series.
2. From the **Document** menu, select **Page Layout > Group**.

   Press doc 5 7.

   The next page is grouped with the first page. The page layout automatically adjusts to display all the pages in the group.

Ungrouping Pages

To ungroup the pages:

1. Select the grouped page.
2. From the **Document** menu, select **Page Layout > Ungroup**.

   —or—

   Press doc 5 8.

   The material becomes individual pages for each application.

Deleting an Application from a Page

1. Click the application you want to delete.
2. From the **Document** menu, select **Page Layout > Delete Application.**

   —or—

Press doc▾ 5 5.

The selected application is deleted.

If you want to undo the delete, press **Ctrl-Z**.

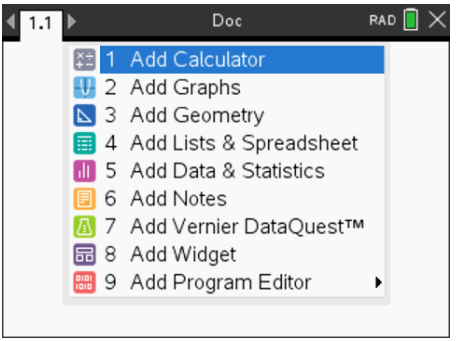
Using the Application Menu

The Application menu enables you to select tools for working with a specific application. Each application has a unique menu.

Using the Application Menu

1. From a blank page, press menu to display the Application menu.

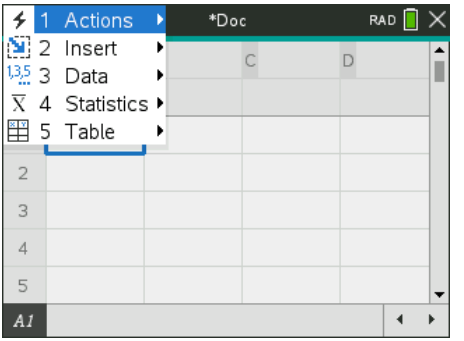
   The menu displays applications that you can add to the page.



2. Press the number of the application you want to add to the page. For example, press 4 to add the Lists & Spreadsheet application.

3. Press menu to display the Application menu, which lists the options for working with the current application.

   The example below displays the Application menu for the Lists & Spreadsheet application.



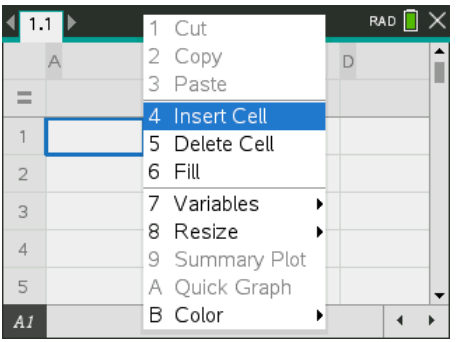
Context Menus

Context menus display options that are specific to the selected object or the current cursor location.

Using the Context Menu

▶ To access a context-sensitive menu from an application, press ctrl menu.

In the example below, the context menu displays options available for the selected cell in Lists & Spreadsheet.



Working with Problems and Pages

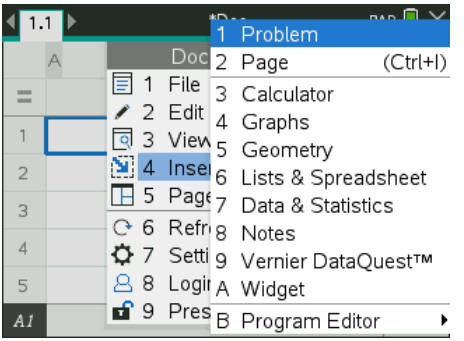
The options on the **Documents** menu let you:

- Save a document
- Access edit functions such as undo, redo, cut, copy, paste, and delete
- Move between pages and open the page sorter view for documents with multiple pages
- Modify page layout, insert pages or problems, delete pages, and change settings
- Add problems, pages, and applications to open documents
- Access page layout options

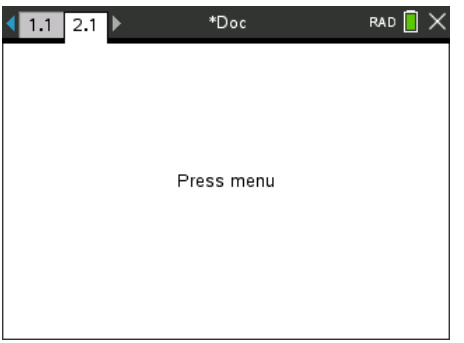
Adding a Problem to a Document

Adding problems to a document enables you to reuse variable names. A document can contain as many as 30 problems. To add a new problem:

1. Press doc 4 1 to open the Insert options.



A new problem with one page is added to the document. The tab at the top left of the screen indicates that this is the first page of the second problem.



2. Press menu to open the Application menu, and then, press the number corresponding to the application you want to add to the new page.

Viewing and Reordering Pages in a Document

The Page Sorter displays all of the problems in your document and all pages within each problem in thumbnail format. You can use the Page Sorter to rearrange and delete pages, copy a page from one problem and paste it into another, and apply templates to pages.

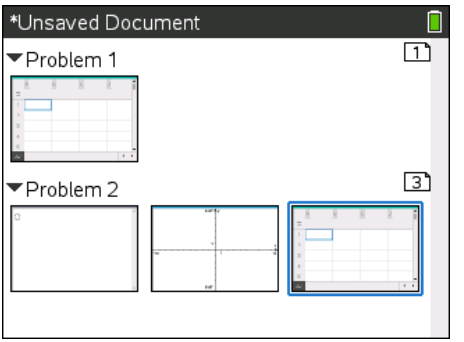
Viewing Multiple Pages with the Page Sorter

Although the handheld typically displays the pages in your document one at a time, the Page Sorter lets you see all of the problems in your document and all pages within each problem in thumbnail format. You can use the Page Sorter to rearrange and delete pages, and copy a page from one problem and paste it in another.

Opening the Page Sorter from a Document

▶ Press ctrl ▲.

The Page Sorter screen displays all of the problems and pages in the current document.

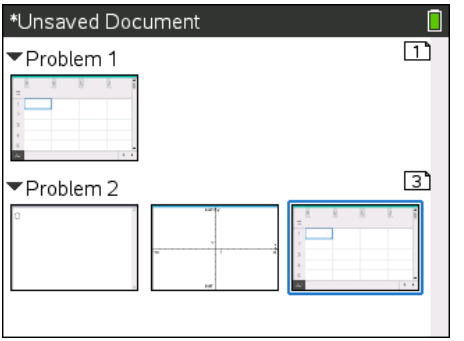


Reordering Pages in a Problem

Use the Page Sorter (press ctrl ▲) to move a page within a problem with multiple pages:

1. Press the ◀ or ▶ key to select the page you want to move.

   A heavy border around the page indicates that it is selected.



2. Either press and hold ⬚ or press ctrl ⬚ until the grab cursor is displayed.
3. Press ◀, ▶, ▲, or ▼ to move the page to the desired position.
4. Press ⬚ or enter to finish the move.

   Note: You can press esc to cancel.

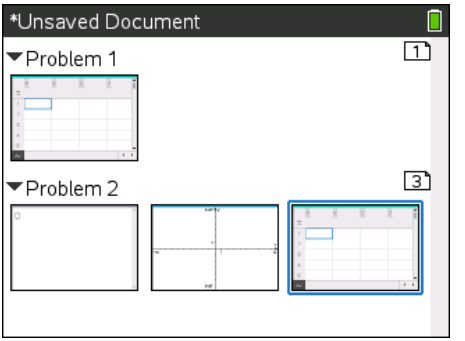
   The page moves to the new location within the problem, and the counter adjusts accordingly.

Copying a Page to Another Problem

To copy a page from one problem to another in the same document:

1. Press ctrl ▲ to open Page Sorter.
2. Press ◀, ▶, ▲, or ▼ to select the page you want to copy.

   A heavy border around the page indicates that it is selected.



3. Press ctrl C to copy the page.
4. Press ◀, ▶, ▲, or ▼ to select the desired position in the problem where you will paste the page. The copied page will be placed after the page you select.
5. Press ctrl V to paste the page in the new location.

   The page is copied to the new location within the problem, and the counter adjusts accordingly.

Note: If the page contains variables with the same names as the new problem, a conflict may occur. Rename the variables if necessary.

Copying a Page to Another Document

To copy a page from one document to another document:

1. Press ctrl ▲ to open the Page Sorter.
2. Press ◀, ▶, ▲, or ▼ to select the page you want to copy.

   A heavy border around the page indicates that it is selected.

3. Press ctrl C to copy the page.
4. Press on 2 to open My Documents.
5. Press ▲ and ▼ to highlight the folder containing the document you want to copy the page to.
6. Press ▶ to open the folder.

—or—

Press menu 3.

7. Press the ▲ and ▼ keys to highlight the document.
8. Press ⭳ or enter to open the document.
9. Press ctrl ▲ to display the Page Sorter.
10. Press ◀, ▶, ▲, or ▼ to move the page to the desired position in the document.
11. Press ctrl V to paste the page in the new location.

    The page moves to the new location within the problem, and the counter adjusts accordingly.

Copying, Pasting, and Deleting Problems

You can copy and paste a single problem from one location to another within the same document or a different document. You can also delete a problem from the document.

Copying and Pasting a Problem

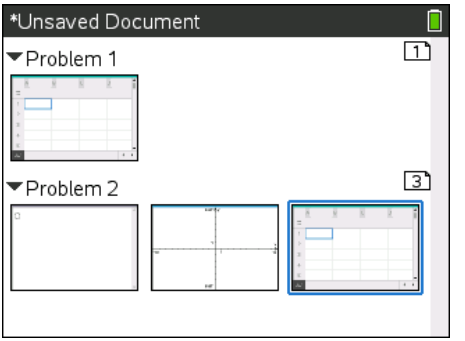
To copy and paste a problem:

1. Open the Page Sorter.

   Press ctrl ▲.

   —or—

   Press doc 3 3.



2. Select the problem. If there are multiple problems, you can press menu 2 to collapse the Page Sorter to list the problems by number and title only.
3. Press ctrl C.
4. Go to the location where you want the problem to appear.

5. Press ctrl V.

   A duplicate problem is placed in the new location.

Deleting a Problem

To delete a problem from the document:

1. Select the problem from the Page Sorter.
2. Press ctrl X.

   The problem is deleted from the document.

Renaming a Problem

To rename a problem:

1. With the document active, open the Page Sorter.

   Press ctrl ▲.
2. Select the problem name.
3. Press ctrl menu.
4. Select 7 **Rename** and type the name.
5. Press ctrl S to save the change.

Adding a Page to a Problem

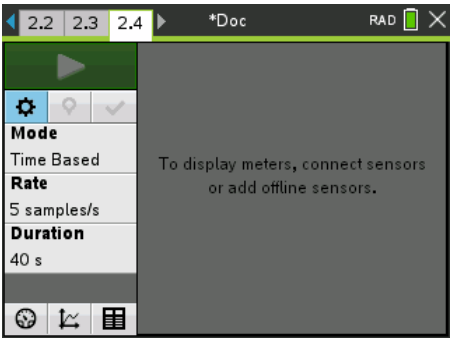
Each problem can contain up to 50 pages. To add a new page to a problem:

▶ Press ctrl doc or ctrl I to add a blank page and select an application.

—or—

▶ Press on to display the Home screen, and then point to the application you would like to add to the new page and click or tap.

A new page is added to the current problem.



Note: The tab at the top left of the screen indicates that this is the second page of the second problem.

Moving Through Pages in a Document

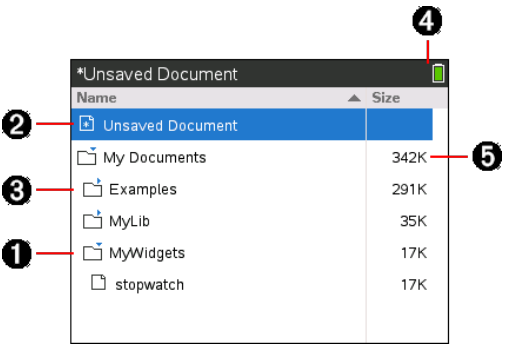
Tabs display up to three multiple pages. When a document contains more than three pages, arrows appear on the left and right of the tabs.

Use the following keys to navigate through your documents.

- ctrl ◀ displays the previous page.
- ctrl ▶ displays the next page.
- ctrl ▲ displays the Page Sorter.
- ctrl ▼ displays the previous view.
- Use the Touchpad to click on the arrows that appear on either side of the tabs to show additional pages in a document containing more than three pages.

Managing Documents

My Documents is a file manager in which you store and organize your documents. The example below illustrates the My Documents screen with its main parts labeled. Following the screen, you can find descriptions of each labeled part.



❶ Expanded folder

❷ Current, unsaved document

❸ Collapsed folder

❹ System status indicators

❺ File size

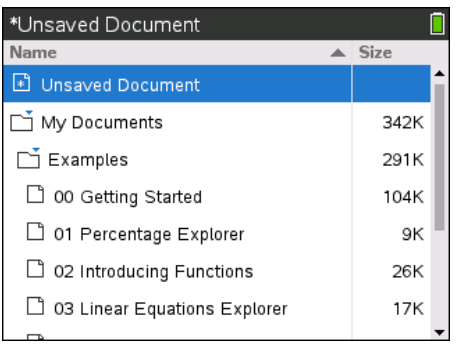
Browsing Files in My Documents

To open **My Documents**:

▶ Press [on] [2].

Note: If you are working in a page, press [ctrl] ▲ [ctrl] ▲.

The **My Documents** screen opens, displaying all folders and files on the handheld.



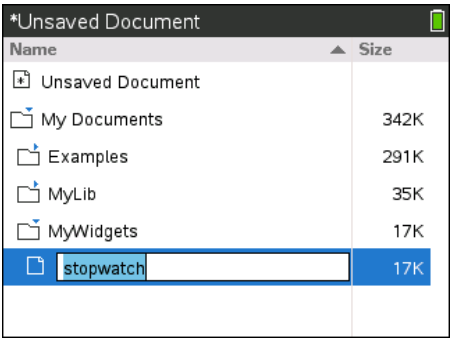
- To sort columns by name or size, click that column head. Click again to change the sort from ascending to descending.
- To scroll through My Documents, click or grab the scroll bar.
- To expand a single folder, point to the folder and click on the folder icon or press [ctrl] ▶. To collapse, click again or press [ctrl] ◀.
- To expand all folders, press [menu] [7]. To collapse, press [menu] [8].

Renaming Folders or Documents

To rename a folder or document:

1. Press the ▲ and ▼ keys to highlight the document or folder you want to rename.

2. Press menu 2.



The document or folder name is highlighted.

3. Type a new name and press enter to complete the change.

Note: Press esc to cancel.

Creating Folders

You can create folders two different ways:

- You can create a folder when you save a new document: The **Save** and **Save As** menu commands allow you to enter a new folder name for the document.
- You can create a folder directly from the My Documents screen. Press menu 1. Type a name for new folder, and press ⇧ or enter to add it.

File and Folder Naming Conventions

Folder names must be unique. File and folder names can be very long, and can include almost all characters, including spaces and punctuation.

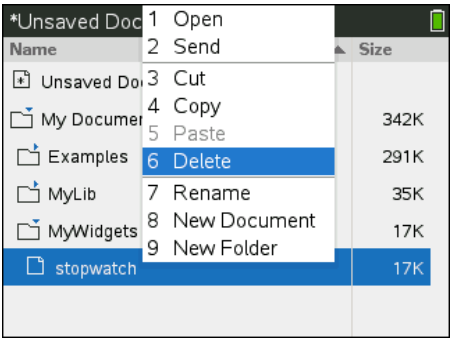
Note: If you are planning to transfer these documents to your computer for use in the TI-Nspire™ software, it is best to use names that are accepted on your computer. Avoid punctuation, \, /, or symbols.

Deleting Documents and Folders

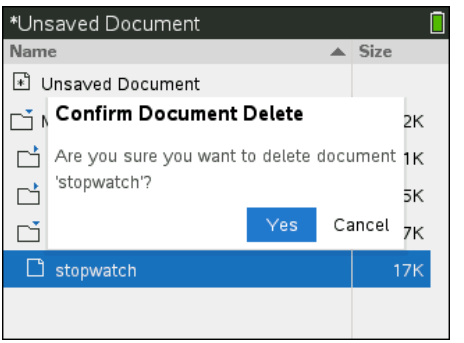
1. Press ▲ and ▼ to highlight the document or folder you want to delete.
2. Press ctrl menu 6.

—or—

Press del.



A dialog box opens, confirming that you want to delete the file or folder.



3. Press ⌨ or enter to select **Yes**.

   The document is deleted.

Duplicating Documents and Folders

Use Copy ctrl C and Paste ctrl V to duplicate documents and folders.

To copy a document to another folder, select the desired folder, and then paste.

Recovering Deleted Documents

Most operations performed in My Documents can be undone. Press ctrl Z (Undo) to cancel the last operation until the deleted document is restored.

Closing a Document

1. To close a document, press doc 1 3.

   —or—

   Press ctrl W.

If you have changed the document, you will be asked whether you want to save those changes.

2. Click **Yes** to save the document or click **No** to abandon the changes.

Understanding the TI-Nspire™ Tools

This section provides an overview of the tools used when working with TI-Nspire™ documents on a handheld, including variables, catalog, symbols, and math templates.

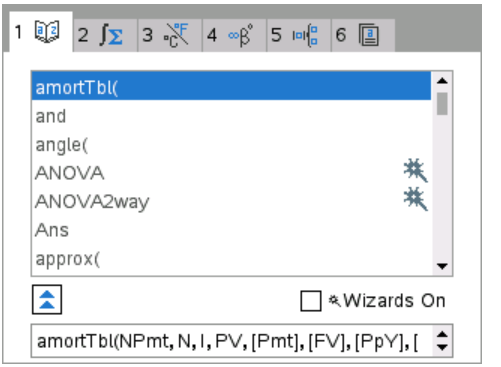
Creating TI-Nspire™ Variables

Variables can be any portion or attribute of an object or function created within an application. Examples of attributes that can become variables are the area of a rectangle, the radius of a circle, the value contained in a spreadsheet cell or the contents of a column, or a function expression. When you create a variable, it is stored in memory within the problem. You will find more information about variables in the chapter titled *Using Variables*.

Using the Catalog

Use the catalog to access a list of TI-Nspire™ commands and functions, units, symbols and expression templates. Commands and functions are listed alphabetically. Commands or functions not beginning with a letter are found at the end of the list (&, /, +, -, and so on). To open the catalog:

1. From an open document, press [book] to open the catalog.



2. Press the number key corresponding to the appropriate tab.

   For example, press [2] to show a list of math functions.

3. Press ▼ until the item you want to insert is highlighted.

   A syntax example for the selected item is displayed at the bottom of the screen.

Note: To see additional syntax examples of the selected item, press tab, and then press enter to maximize or minimize the Help. To move back to the selected item, press shift tab.

4. Press enter to insert the item.

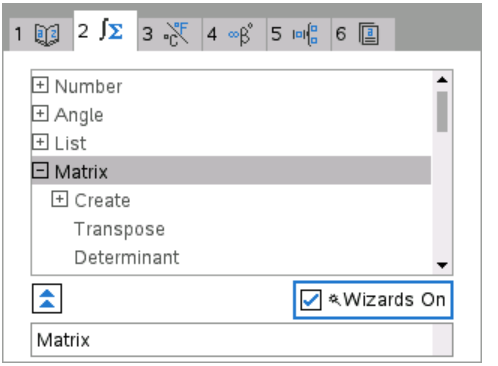
About the Catalog Window

The catalog window uses these tabs to categorize commands, special characters, and templates in documents:

1	Contains all commands and functions, in alphabetical order
2	Contains all math functions
3	Provides the values for standard measurement units
4	Provides a symbol palette for adding special characters
5	Contains math templates for creating two dimensional objects, including product, sum, square root, and integral
6	Shows public library (LibPub) objects.

Using Wizards

Some catalog functions have a wizard to help you enter function arguments. To use a wizard, press tab until the **Wizards On** box is highlighted. Press ctrl or enter to select the check box.



Entering Special Characters

The symbol palette contains a subset of the objects found in the catalog. To open the symbol palette:

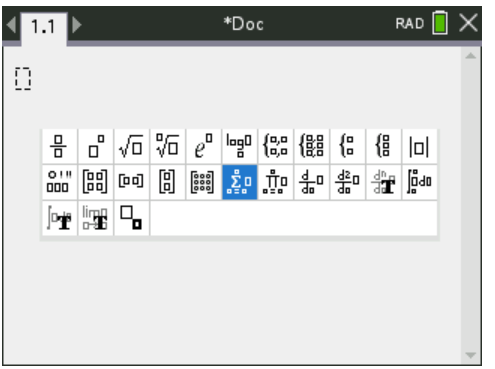
1. In an open document, press ctrl 📖.

2. Press ◀, ▶, ▲, or ▼ to select a symbol.
3. Press enter to insert the symbol.

Entering Math Expressions

Use math expression templates to create two-dimensional objects such as summation, integral, derivative, and square root. To open the math expressions palette:

1. In an open document, press 🔣.



2. Press ◀, ▶, ▲, or ▼ to select an expression.
3. Press ⬚ or enter to insert the expression.

Entering International Language Characters

Use the ⒻⓅ key to enter specially accented or punctuated characters in applications such as Notes that allow text input.

1. Open an application such as Notes that allows text input.
2. Type the desired text.
3. Position the cursor after the letter that you want to accent. For example, “e” while in the French locale.
4. Press ⒻⓅ on the keypad. Notice that the “e" changes to “é.“ Keep pressing ⒻⓅ until you find the accented version of e that you want. Press [␣] or the next letter of your text to accept the character and continue typing.

Working with Images

Images can be used in TI-Nspire™ applications for reference, assessment, and instructional purposes. You can add images to the following TI-Nspire™ applications:

- Graphs & Geometry
- Data & Statistics
- Notes
- Question, including Quick Poll

In the Graphs & Geometry and Data & Statistics applications, images are set in the background behind the axis and other objects. In the Notes and Question applications, the image is set at the cursor location inline with the text (in the foreground).

You can insert the following image file types: .jpg, .png, or .bmp.

Note: The transparency feature of a .png file type is not supported. Transparent backgrounds are displayed as white.

Working with Images on a Handheld

On a handheld, images can be copied from one document to another or resized or repositioned within a document. You can also delete images from a document.

You cannot add or insert images into a document when working on a handheld. However, you can transfer a document containing an image from your computer to a handheld.

Note: If there is not enough storage on the handheld to accommodate a document containing an image, an error message is displayed.

Copying an Image

Complete the following steps to copy an image from one document to another or from one page to another within the same document.

1. Open the document that contains the image you want to copy.
2. Select the image.
   - In the Question or Notes applications, move the cursor over the image and press [ctrl].
   - In the Graphs & Geometry application, press [menu] [1] [2] [2].
   - In the Data & Statistics application, press [menu] [3] [6].

   A border appears around the image.
3. Press [ctrl] [menu], and then click **Copy**. You can also press [ctrl] [C].
4. Open the document where you want to paste the image or select a page in the current document.

Note: If you open a new document, you will be prompted to save and close the current document.

5. Press ctrl V.

   Note: If pasting an image into the Graphs & Geometry application, press enter, and then press ctrl V.

   The image is copied to the page in the document.

Repositioning an Image

Complete the following steps to reposition an image on a page.

1. Open the document and navigate to the page that contains the image.
2. Select the image.
   - In the Question or Notes applications, move the cursor over the image, and then press, hold, and release ⬚. The image appears shaded.
   - In the Graphs & Geometry application, press menu 1 2 2.
   - In the Data & Statistics application, press menu 3 6.

     A border appears around the image.
3. Move the image.
   - In the Question or Notes applications, move the cursor to the new location and press ⬚.
   - In the Graphs & Geometry or Data & Statistics applications:
     - Press and hold ⬚ until the cursor changes to a four-sided arrow (✣). The image floats in the background and the border changes to a dashed line.
     - Move your finger over the Touchpad to move the image to the new location, and then press ⬚ or enter to place the image.

Resizing an Image

Complete the following steps to resize an image on a page.

1. Open the document that contains the image.
2. Select the image.
   - In the Question or Notes applications, or in Quick Poll, move the cursor over the image and press, hold, and then release ⬚. The image appears shaded.
   - In the Graphs & Geometry application, press menu 1 2 2.
   - In the Data & Statistics application, press menu 3 6.

     A border appears around the image.
3. Move the cursor to one of the corners.

The cursor changes to a four-sided directional arrow (✥).

Note: If you move the cursor to the edge of an image, the cursor changes to a two-sided directional arrow. You can drag the image left or right to resize it, but the image will become distorted.

4. Press [ctrl].

   The tool is enabled.

5. Move your finger over the Touchpad in any direction to resize the image.

   A dashed line appears to indicate the new size.

6. To accept the new size, press [ctrl] or [enter].

Deleting an Image

Complete the following steps to remove an image from a page.

1. Open the document that contains the image.
2. Select the image.
   - In the Question or Notes applications, move the cursor over the image, and then press, hold, and release [ctrl]. The image appears shaded.
   - In the Graphs & Geometry application, press [menu] [1] [2] [2].
   - In the Data & Statistics application, press [menu] [3] [6].

     A border appears around the image.

3. Press [ctrl] [menu], and then select **Delete**.

   The image is removed.

   Note: In the Question and Notes applications, you can also press [del] to remove a selected image.

Working in a TI-Nspire™ CX Premium Teacher Software Classroom

If you are in a classroom where TI-Nspire™ CX Premium Teacher Software is used, you will need to log in to class to communicate with the teacher's computer. The teacher can communicate with your handheld in the following ways:

- Send files
- Collect files
- Delete files
- Send Quick Polls and receive Quick Poll responses

The teacher can also pause and restart your handheld. When class is paused, you will receive a message on your handheld. You cannot use your handheld until the teacher releases the handheld from pause mode.

Using Wireless Communication Hardware

Teachers using TI-Nspire™ CX Premium Teacher Software in the classroom can attach wireless cradles and/or network adapters to students' TI-Nspire™ CX handhelds. Those handhelds can then link wirelessly to an access point attached to the teacher's computer.

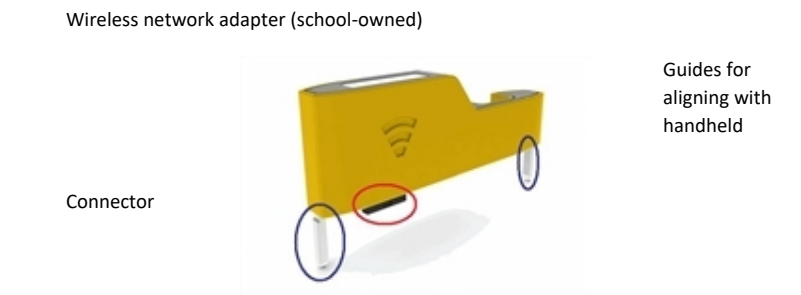
You can attach any the following devices to TI-Nspire™ CX handhelds:

- TI-Nspire™ CX Wireless Network Adapter - v2 (2.4 GHz or 5.0 GHz band)
- TI-Nspire™ Wireless Network Adapter (2.4 GHz)

Attaching a Wireless Adapter to a CX Handheld

Note: The battery in the handheld powers the wireless adapter.

1. Position the wireless adapter on top of the handheld so the connector on the adapter lines up with the connector on top of the handheld.



2. Slide the adapter into position, making sure the guides on the sides of the adapter slide into the grooves on the sides of the handheld.

Side view of handheld

Groove to align wireless adapter

3. Firmly press the adapter into place so that the adapter sits on top of the handheld as shown in the following illustration.

Note: The TI-Nspire™ CX handheld can be charged with the wireless adapter attached.

Connecting to the TI-Nspire™ CX Navigator™ System

To connect to the TI-Nspire™ CX Navigator™ network, you must log in to the network from your handheld. Before you can log in, the teacher must complete the following tasks:

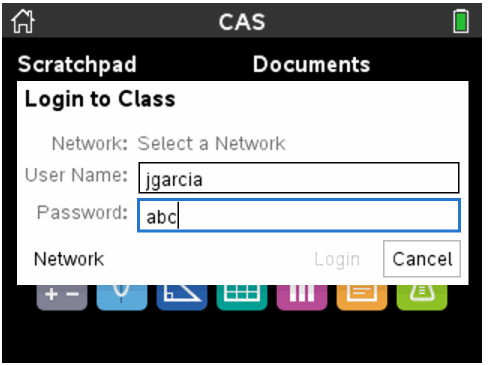
- Start a class session on their computer.

- Provide you with the class network name, a username and, if necessary, a password.

Logging in to the Network

1. Attach a wireless adapter or wireless cradle to the handheld.
2. Ensure your TI-Nspire™ CX II handheld is ready for login. (The icon is blinking.)
3. Complete one of the following actions:
   - From the Home screen, press 5 5.
   - From an open document, press doc 8.

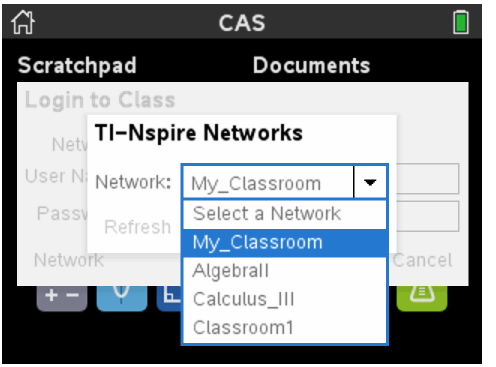
   The Login to Class dialog box opens and the last network that was associated with the wireless client appears.



   Note: If the handheld is connected to the computer with the USB cable, no network names appear on the screen, and you can continue logging in.

4. If the name of the network that appears is correct, click **Login**. If the network is not correct, click **Network.**

   The handheld screens displays the last network the wireless client was attached to, and also displays other networks within range.



5. Select the network from the list, and then click **Connect**.

   The login screen shows the connection status and displays the network name when the connection is successful.

6. Type your username and password.
7. Select **Login**.

   The Login Successful screen opens.

8. Click **OK**.

TI-Nspire™ Handheld Login Status Icons

The icons on the TI-Nspire™ CX II and TI-Nspire™ CX II CAS handheld screens indicate the communication status between the handheld and the access point, wireless adapter, wireless cradle, or TI-Navigator™ network. The icons indicate status as follows.

Icon	Status	Meaning
	Blinking	The handheld is searching for an access point.
	Solid	The handheld has found an access point.
	Solid	The handheld is not communicating with the adapter or cradle. Remove the handheld from the adapter or cradle, wait for the icon to disappear, and then reattach the handheld to the adapter or cradle.

Icon	Status	Meaning
	Blinking	The handheld is connected to the network and is ready to login.
	Solid	The handheld is logged in to the network.

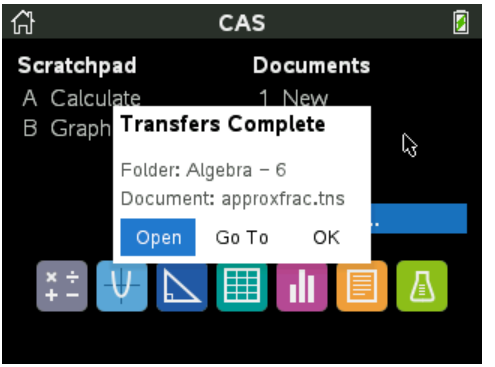
Understanding File Transfers

During a class session, the teacher can send files to student handhelds and collect or delete files from student handhelds.

Note: Before class starts, teachers can set up actions to send or collect files. When you log in, the files are sent or collected. If the teacher set up actions to both send and collect files, you will only see the dialog box for the last action completed.

Opening Sent Files

When the teacher sends a file to your handheld, the Transfers Complete dialog box opens.



- Click **Open** to open the file. If the teacher sent multiple files, this opens the last file in the list.

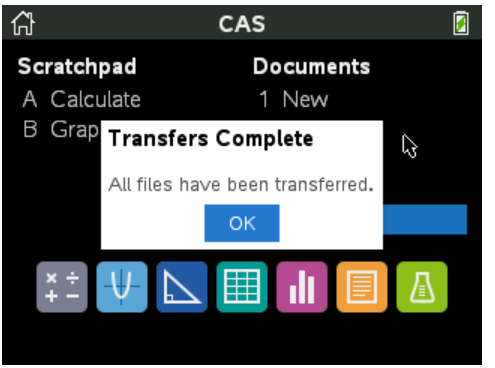
  Note: The files are received alphabetically by name, no matter which order the teacher sent them in. The last file in the list is the last alphabetical file.

- Click **Go To** to go to the location on the handheld where the file was sent. The file name is highlighted. You can open that file, or navigate to another file. If the teacher sent multiple files, the last alphabetical file in the list is highlighted.

- Click **OK** to dismiss the dialog box without opening the file. Your handheld returns to the state it was in when the message was sent.

Collecting or Deleting Files

Your teacher may collect or delete files from your handheld during a class session. For example, teachers can collect homework assignments or delete certain files prior to a test. When the teacher collects or deletes files, you receive a message on your handheld.



▶ Click **OK** to dismiss the message.

Configuring Handhelds

This chapter provides information needed to:

- Maintain batteries used in the handheld.
- Change the default settings.
- Attach a wireless module when the handheld is used in the classroom.

Checking Battery Status

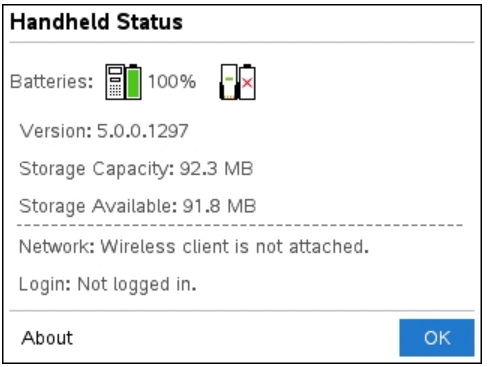
To check the status of the TI-Nspire™ Rechargeable Battery in a handheld:

1. Press [on].

   The **Home** screen opens.

2. Press [5] [4] (**Settings > Status**).

   The **Handheld Status** dialog box opens.



Battery status is shown here.

3. Click **OK** or press [enter] to close the window.

Note: From an open document, press [doc] [7] [4] ([doc] **> Settings & Status > Status**).

Recharging the Handheld

To recharge the TI-Nspire™ Rechargeable Battery in a handheld, connect it to any of the following power sources:

- A standard USB cable connected to a computer
- A TI USB wall charger (sold separately)
- A TI-Nspire™ CX Docking Station if in a classroom setting

The amount of time required to fully charge the battery may vary, but charging normally takes about six hours. It is not necessary to remove the TI-Nspire™ Rechargeable Battery from the handheld to recharge it. The handheld operates normally while it is attached to a charging source.

Recharging a Battery from a Computer

To recharge a handheld from a computer, a TI-Nspire™ USB driver must be installed. USB drivers are standard with any TI-Nspire™ software, which includes:

- TI-Nspire™ CX Premium Teacher Software
- TI-Nspire™ CX CAS Premium Teacher Software
- TI-Nspire™ CX Student Software
- TI-Nspire™ CX CAS Student Software

To download software that includes a driver, go to education.ti.com/software.

Understanding the Priority of Power Sources

When the TI-Nspire™ Rechargeable Battery is fully charged, the handheld draws power in the following order:

- First, from a connected external power source, such as:
  - A computer connected through a standard USB cable
  - An approved wall charger (sold separately)
- Second, from the TI-Nspire™ Rechargeable Battery

Disposing of Used Batteries Safely and Properly

Do not mutilate, puncture or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries according to local regulations.

Changing Handheld Settings

Use the options on the Settings menu to change or view the following settings:

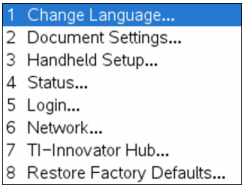
- Change language
- Settings (Document and Graphs & Geometry)
  - Define or restore settings for open documents and the Scratchpad
  - Define or restore default settings for the handheld
- Handheld Setup
- Status
- Login

Note: Not all options are accessible at all times. Options that are unavailable are disabled.

Opening the Settings Menu

▶ From the Home screen, press 5 or use the Touchpad to select Settings.

The Settings menu opens.



Changing a Preferred Language

Complete the following steps to change a preferred language:

1. From the Home screen, press 5 or select **Settings** to open the menu.
2. From the menu, select **Change Language** or press 1.

   The Change Language dialog box opens.

3. Press ▶ to open the drop-down list.
4. Press ▼ to highlight a language, then press ⬚ or enter to select it.
5. Press tab to highlight the **OK** button, and then press ⬚ or enter to save the language selection.

Customizing the Handheld Setup

Handheld setup options enable you to customize options to suit your needs.

- Font size (small, medium or large).
- Power standby. (1, 3, 5, 10 or 30 minutes).
  - Use this option to extend battery life.
  - By default, the handheld automatically powers down after three minutes of inactivity.
- Hibernate (1, 2, 3, 4, 5 days or never).
  - Use this option to extend battery life.
  - When hibernating, the handheld saves current work in memory.

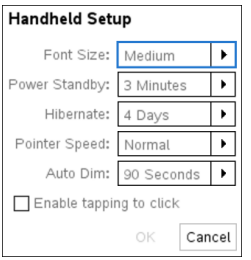
- When you turn the handheld on again, the system reboots and opens saved work.

- Pointer speed (slow, normal or fast).
- Auto dim (30, 60 or 90 seconds, and two or five minutes).
- Enable tapping to click.

Changing Handheld Setup Options

1. From the **Home** screen, press 5 3 (**Settings > Handheld Setup**).

   The Handheld Setup dialog box opens.



2. Press tab until the desired category is highlighted.
3. Press ▶ to view the list of possible settings.
4. Press ▼ to highlight the desired setting.
5. Press ⎆ or enter to select the new setting.
6. When you have changed all the settings to suit your needs, press tab until **OK** is highlighted, then press ⎆ or enter to apply your changes.

Customizing Document Settings

Document settings control how the handheld displays and interprets information in TI-Nspire™ documents and in Scratchpad. All numbers, including elements of matrices and lists, are displayed according to the document settings. You can change the default settings at anytime and you can also specify settings for a particular document.

Document settings and their possible values are listed in the following table.

Field	Values
Display Digits	• Float • Float1 - Float12 • Fix0 - Fix12
Angle	• Radian • Degree

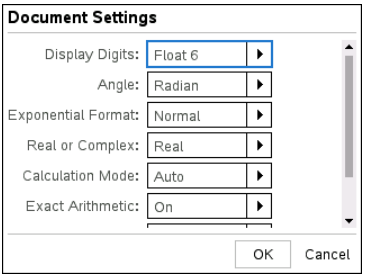
Field	Values
	• Gradian
Exponential Format	• Normal • Scientific • Engineering
Real or Complex	• Real • Rectangular • Polar
Calculation Mode	• Auto • Exact • Approximate **Note:** Auto mode shows an answer that is not a whole number as a fraction except when a decimal is used in the problem. Exact mode (CAS only) shows an answer that is not a whole number as a fraction or in symbolic form, except when a decimal is used in the problem.
Exact Arithmetic	• On • Off **Note:** This option is only available on Exact Arithmetic handhelds.
CAS Mode	• On • Exact Arithmetic • Off **Note:** This option is only available on CAS handhelds and software.
Vector Format	• Rectangular • Cylindrical • Spherical
Base	• Decimal • Hex • Binary
Unit System	• SI • Eng/US **Note:** This option is only available on CAS handhelds and software.

Changing Default Document Settings

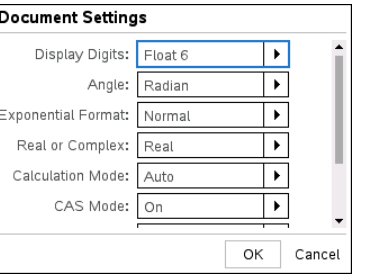
Complete the following steps to define default document settings for TI-Nspire™ documents and Scratchpad.

1. Save and close any open documents.
2. From the Home screen, press 5 2 (**Settings > Document Settings**).

   The Document Settings dialog box opens.



Exact Arithmetic OS



CAS OS

3. Press tab to move through the list of settings. Press ▲ to move backward through the list.

   A bold line around a box indicates it is active.

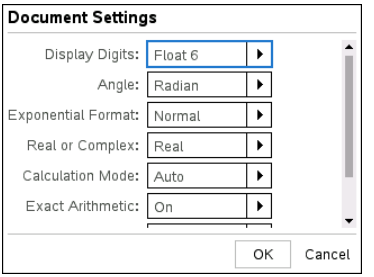
4. Press ▶ to open the drop-down list to view the values for each setting.
5. Press the ▲ and ▼ keys to highlight the desired option, then press ⬚ or enter to select the value.
6. Click **OK** to save the settings as default settings that will be applied to all new TI-Nspire™ documents and to Scratchpad.

Changing Document Settings in a TI-Nspire™ Document

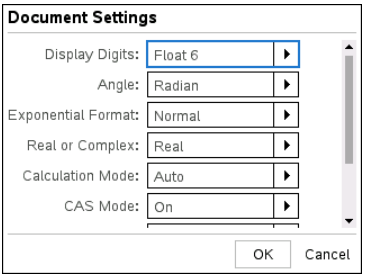
Complete the following steps to change document settings for an open TI-Nspire™ document. The settings will also be applied to Scratchpad and used as the default for all new documents.

1. From an open document, press ⌂ on 5 2 (⌂ on **> Settings > Document Settings**).

   The Document Settings dialog box opens.



Exact Arithmetic OS



CAS OS

2. Press tab to move through the list of settings. Press ▲ to move backward through the list.

   A bold line around a box indicates it is active.

3. When you reach the desired setting, press ▶ to open the drop-down list to view values for each setting.

4. Press the ▲ and ▼ keys to highlight the desired option, then press ctrl or enter to select the value.

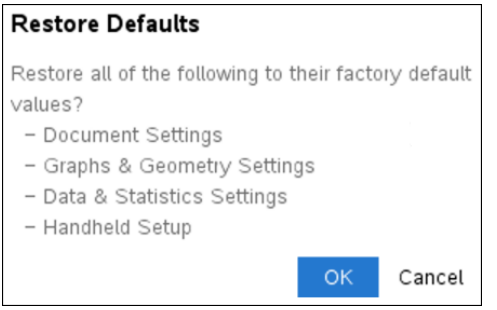
5. Click **OK** or press ctrl or enter to apply the new settings to the open document, and to set as the default for new documents and Scratchpad.

Restoring Document Settings

Complete the following steps to restore the original factory settings to open or new documents, and to the Scratchpad.

1. From the Home screen, press 5 8 (**Settings > Restore Factory Defaults**).

   The Restore Defaults dialog box opens.



2. Click **OK** to restore settings to the factory default settings.

3. Press esc or click **Cancel** to return to the **Home** screen without making changes.

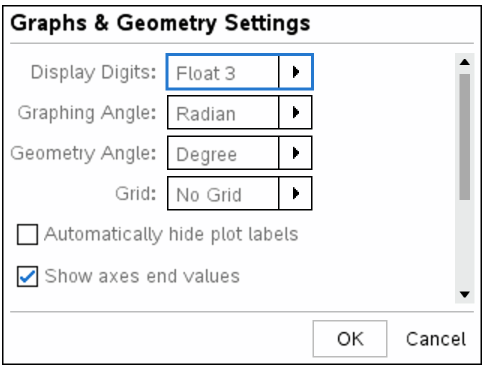
Customizing Graphs & Geometry Settings

Graphs & Geometry settings control how information is displayed in open problems and in subsequent new problems. When you customize application settings, your selections become the default settings for all of your work in the Graphs and Geometry applications.

Complete the following steps to change the Graphs & Geometry Settings and make these settings the default for all new graphs and geometry documents and Scratchpad.

1. Open a document with the Graphs or Geometry application active.
2. Press menu 9 (menu **> Settings**).

   The Graphs & Geometry Settings dialog box opens.



3. Press tab to move through the list of settings. Click ▶ to open the drop-down list to view the values for each setting.

Field	Values
Display Digits	Auto Float Float1 - Float12 Fix0 - Fix12
Graphing Angle	Auto Radian Degree Gradian
Geometry Angle	Auto Radian Degree

Field	Values
	Gradian
Grid	No Grid Dot Grid Lined Grid

4. Press ▼ to view the values, then press [ctrl] or [enter] to select a value.
5. In the lower half of the dialog, select a checkbox to enable an option or clear a checkbox to disable an option.

Checkbox	Operation when selected
Automatically hide plot labels	Plot labels display only when a plot is hovered, selected or grabbed.
Show axis end values	Displays a numeric label at the least and greatest values visible on an axis.
Show tool tips for function manipulation	Shows helpful information as you manipulate function graphs.
Automatically find points of interest	Shows zeros, minima and maxima for graphed functions and objects while tracing function graphs.
Force geometric triangle angles to integers	Restricts the angles of a triangle to integer values as you create or edit the triangle. This setting applies only in the Geometry View with the Geometry Angle unit set to Degree or Gradian. It does not apply to analytic triangles in Graphing View or to analytic triangles in the Analytic Window of the Geometry View. This setting does not affect existing angles, and it does not apply when constructing a triangle based on previously inserted points. By default, this setting is deselected.
label points	Applies labels (A, B, ..., Z, A_1, B_1, and so on) to points, lines, and vertices of geometric shapes as you draw them. The labeling sequence starts at A for each page in a document. By default, this setting is deselected. **Note:** If you create a new object that uses existing unlabeled points, those point are not automatically labeled in the completed object.

6. Choose one of the following options:
   - To apply the settings to the open document only, click **OK**.

- Click **Cancel** to close the dialog box without making changes.

Viewing Handheld Status

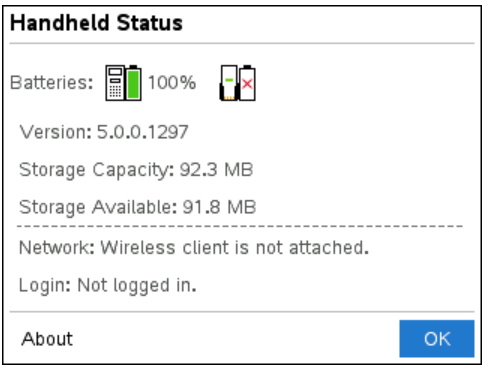
The Handheld Status screen provides the following information about the current state of the handheld:

- Battery status for the rechargeable batteries
- Software version
- Storage capacity and amount of storage available
- Network (if any)
- Your student login name and whether you are logged in
- About

Opening the Handheld Status Screen

1. From the Home screen, press 5 4 (**Settings > Status**).

   The Handheld Status screen opens.



2. Click **OK** to close the Handheld Status screen.

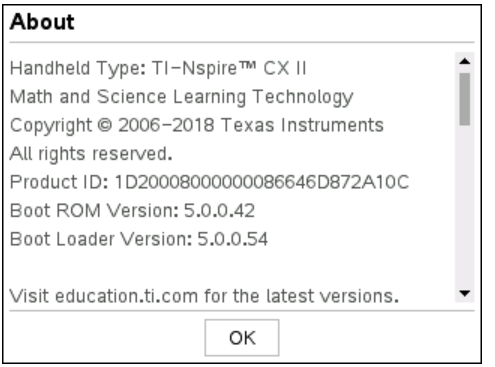
Viewing Handheld Details

The About screen provides additional information about the handheld type, the operating system (OS) version, and the product ID.

1. From the Home screen, press 5 4 (**Settings > Status**).

   The **Handheld Status** screen opens.

2. Click **About** to view details about the handheld.



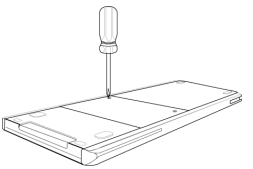
3. Click **OK** to close the About dialog box.
4. Click **OK** to return to the Home screen.

Replacing TI-Nspire™ Rechargeable Batteries

When you replace the battery, complete the following steps to insert the TI-Nspire™ Rechargeable Battery into a handheld.

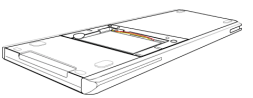
Note: Your handheld may not exactly match these illustrations.

1. Use a small screwdriver to release the panel from the back of the handheld.

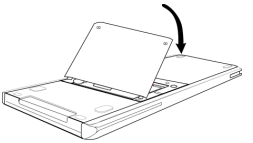


2. Remove the panel.

3. Remove the old battery.
4. Insert the rechargeable battery into its compartment.



5. Replace the back panel and fasten it with a screwdriver.



Precautions for Rechargeable Batteries

- Do not expose batteries to temperatures above 140°F (60°C).
- Do not disassemble or mistreat batteries.
- Use only the charger recommended for the cell or battery, or the one that was provided with the original equipment.
- TI recommends that you use the USB cable included with this calculator. If you choose to use a third-party power adapter with the TI-supplied USB cable, you should use an adapter that meets applicable safety and operational standards and certifications, including UL and CE certifications.

Take these precautions when replacing rechargeable batteries:

- Replace only with a TI approved battery.
- Remove the cell or battery from the charger or alternating current adapter when not in use or being charged.
- Use of the battery in other devices may result in personal injury or damage to equipment or property.
- Do not mix brands (or types within brands) of batteries. There is a risk of explosion if a battery is replaced by the wrong type.

Disposing of Batteries

Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries according to local regulations.

Connecting Handhelds and Transferring Files

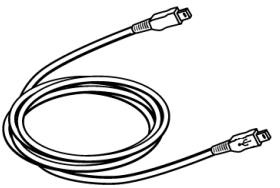
This chapter describes how to connect one TI-Nspire™ CX II handheld to another, how to connect handhelds to a computer, and how to transfer files between them.

The TI-Nspire™ handhelds have a USB port that enables connectivity with another TI-Nspire™ handheld or with a computer.

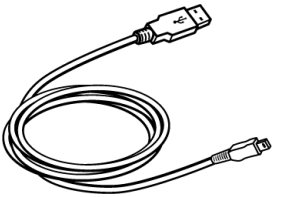
For web-based connectivity using your TI-Nspire™ CX II with a Chromebook, Windows® computer, or Mac® computer, go to TI-Nspire™ CX II Connect.

Connecting Handhelds

You can use USB cables to connect two TI-Nspire™ handhelds or to connect a TI-Nspire™ handheld to a computer.

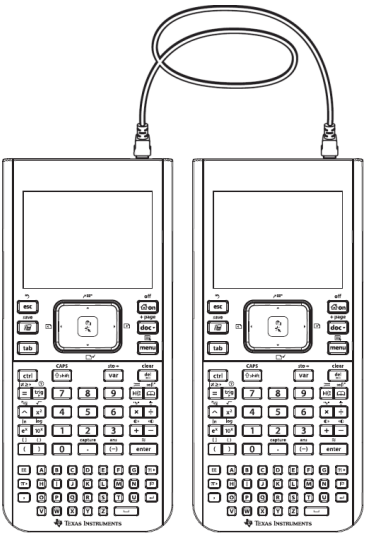


TI-Nspire™ handheld mini-USB cable to connect two TI-Nspire™ handhelds.



TI-Nspire™ USB connection cable to connect the handheld to a computer.

Connecting Two TI-Nspire™ Handhelds with the Mini-USB Cable



The USB port is located on the top of the TI-Nspire™ CX II handheld on the right side when holding the handheld with the screen facing you.

1. Firmly insert either end of the mini-USB cable into the USB port.
2. Insert the other end of the cable into the receiving handhelds's USB port.

Connecting the TI-Nspire™ Handheld to a Computer

1. Firmly insert the mini-USB end of the cable into the port at the top of your handheld.
2. Firmly insert the USB end of the cable into the USB port of the computer.

Transferring Files between Handhelds

You can send documents, Operating System (OS) files, and folders to another TI-Nspire™ handheld.

Note: TI-Nspire™ CX handhelds must be running v4.5.1 or later of the OS in order to transfer to or from TI-Nspire™ CX II handhelds.

Rules for Transferring Files and Folders

- You can transfer documents and OS files.
- Operating systems are not interchangeable between different handheld types. For example, you cannot transfer a CAS operating system to a non-CAS handheld.
- If a document with the same name as the one you are sending already exists on the receiving handheld, the document will be renamed. The system appends a number to the name to make it unique. For example, if Mydata existed on the receiving handheld, it would be renamed Mydata(2).

  Both the sending and receiving handhelds will display a message that shows the new name.
- There is a 255-character maximum length for a file name, including the entire path. If a transmitted file has the same name as an existing file on the receiving handheld and the file names contain 255 characters, the name of the transmitted file will be truncated to enable the software to follow the renaming scheme described in the previous paragraph.
- All variables associated with the document being transmitted are transferred with the document.
- Transmissions will time out after 30 seconds.

Caution: Some older TI-Nspire™ handhelds cannot receive folders; only files. If you receive an error in sending to an older TI-Nspire™ handheld, see *Common error and notification messages*.

Sending a Document or Folder to Another Handheld

1. Ensure the two handhelds are connected.
2. Open the My Documents file browser and navigate to the file or folder you want to transfer.
3. Press the ▲ and ▼ keys on the Touchpad to highlight the document or folder you want to send.
4. Press doc▾ 1 6 to select **Send** from the Documents menu.

5. The file transfer begins. A progress bar shows the status of the transfer. There is also a cancel button in the Sending... dialog box to enable you to cancel the transmission while it is in progress.

   At the end of a successful transmission, the message "<Folder / File name> transferred as <Folder / File name>." is displayed. If the file had to be renamed on the receiving handheld, the message will show the new file name.

Receiving a Document or Folder

No action is required by the user of the receiving TI-Nspire™ handheld. Handhelds are automatically powered on when the cable is attached.

At the end of a successful transmission, the message "<Folder / File name> received." is displayed. If the file had to be renamed, the message will show the new file name.

Caution: Some older TI-Nspire™ handhelds cannot receive folders; only files. If you receive an error in sending to an older TI-Nspire™ handheld, see *Common error and notification messages*.

Canceling a Transfer

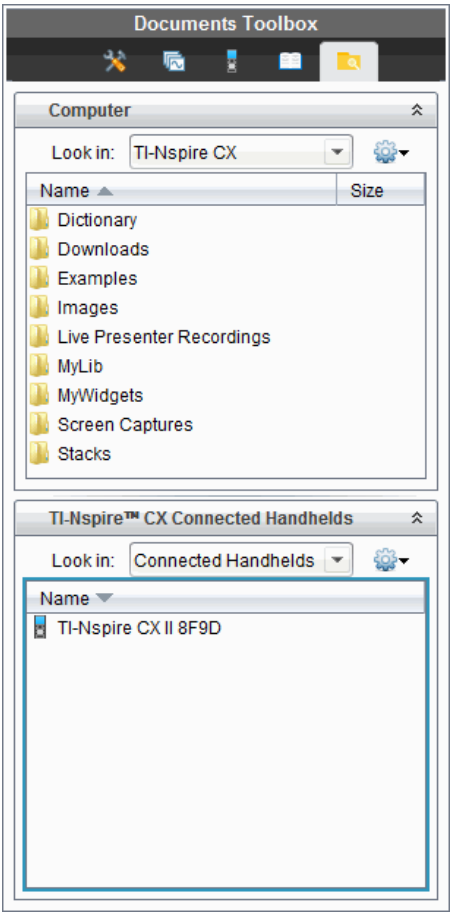
1. To cancel a transmission in progress, press **Cancel** on the sending handheld. The user of either handheld can also press esc.
2. Press esc or enter to cancel the transmission error message.

Transferring Files between Computers and Handhelds

In the Documents Workspace, teachers and students can use the "drag and drop" method to quickly transfer files and folders from a computer to a handheld or transfer files from a handheld to a computer.

Note: You must be running v5.0 or later of the TI-Nspire™ software in order to transfer to or from TI-Nspire™ CX II handhelds.

1. Connect the handheld to the computer using a standard A to mini-B USB cable.
2. In the TI-Nspire™ software, open the Documents Workspace.
3. In the Documents Toolbox, click  to open the Content Explorer.



Computer panel

Connected Handhelds

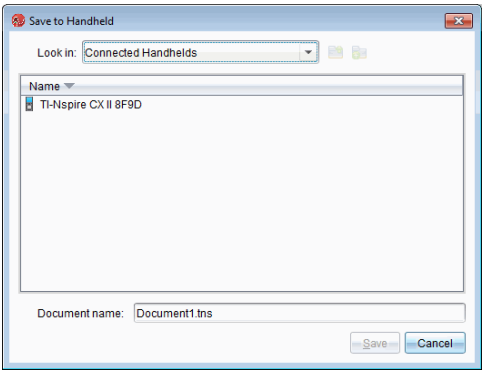
4. Navigate to the folder that contains the file you want to transfer.
   - To transfer a file from a handheld to the computer, click the file, and then drag the file to a folder in the Computer panel.
   - To transfer a file from the computer to a handheld, click the file, and then drag the file to a connected handheld.

Note: Those using the TI-Nspire™ CX Premium Teacher Software or the TI-Nspire™ CX Navigator™ Teacher Software can also use options in the Content Workspace to transfer files from a handheld to a computer.

Using the Save to Handheld Option

In the Documents Workspace, you can also use the Save to Handheld option on the File menu to transfer a file to a connected handheld when you want to save a file to a specific folder on the handheld.

1. Ensure the handheld is connected to the computer.
2. In the Computer panel, navigate to the folder where the file is located.
3. Click the file.
4. Click **File > Save to Handheld**. The Save to Handheld dialog box opens.



5. Double-click the handheld name, and then navigate to the folder where you want to save the file.
6. Click **Save**. The file is saved to the selected folder and the Save to Handheld dialog box closes.

Handling Errors Resulting from Sending Folders

If you receive an error after attempting to send a file, it may mean the receiving handheld has an operating system that does not support the transfer. To resolve this, update the receiving handheld's OS and try the send again.

Common Error and Notification Messages

Shown on	Message and Description
Sending handheld	"This folder structure is not supported on the receiving handheld. The receiving handheld's OS may need to be updated, which you can do by selecting Send OS from the My Documents menu." OK
	If you get an error when sending a folder to an older TI-Nspire™ handheld, try updating the OS on the receiving handheld. If the error persists, you may have to send the files individually.

Shown on	Message and Description
Sending handheld	**"Transfer failed. Check cable and try again."** **OK**
	This message is displayed if a cable is not attached to the sending handheld's link port. Remove and then reinsert the cable and try the document transmission again. Click **OK** to cancel the transmission message. **Note:** The sending handheld may not always display this message. Instead, it may remain BUSY until you cancel the transmission.
Sending handheld	**"Receiver does not have enough storage space for file transfer."** **OK**
	This message indicates that the receiving handheld does not have enough storage to accept the file being transmitted. The user of the receiving handheld must free space to obtain the new file. To do this: • Delete unneeded files. • Store files on a computer for later retrieval, and then delete them from the TI-Nspire™ handheld.
Sending handheld	**"<folder>/<filename> transferred as <folder>/<filename(#).>"**
	This message is displayed at the end of a successful transfer when the file had to be renamed because a file already exists on the receiving handheld with the original name. The transmitted file is renamed by appending a number to the end of the name. Rename numbering always begins with (2) and can increment by one, as needed.
Sending handheld	**"<folder>/<filename> transferred as <folder>/<new filename>."**
	This message indicates that a new folder was created on the receiving handheld to contain the transmitted document.
Receiving handheld	**"<folder>/<filename(x)> received."**
	This message indicates that the receiving handheld has a document with the same name as the document being sent.
Receiving handheld	**"<new folder>/<new filename> received."**
	This message indicates that a new folder has been created to contain the transmitted document.

Shown on	Message and Description
Receiving handheld	**"Transfer failed. Check cable and try again."** **OK**
	This message indicates that the cable is not correctly attached to the receiving handheld's link port. Remove the cable then reattach it and try the transmission again. Click **OK** to cancel the transmission message.

File Management

The TI-Nspire™ CX II Handheld comes equipped with 128 MB of Flash storage. The operating system uses part of that storage, and saving new documents on the handheld further reduces the amount of available storage over time. To avoid or resolve storage space issues, use one of the following options:

- Delete documents and folders you no longer use.
- Back up files and folders to another handheld or computer.
- Reset the storage, which deletes ALL files and folders on the handheld.

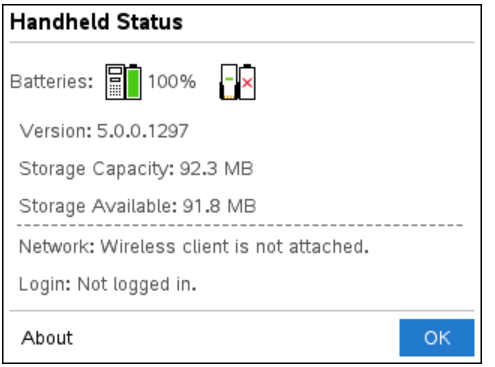
Checking Available Storage

Complete the following steps to view the amount of storage (in bytes) that is available on your handheld.

1. From the Home screen, select **Status** from the **Settings** menu.

   Press [on] [5] [4].

   The Handheld Status window opens.



2. View the **Storage Available** field to determine how much storage is available on the handheld.
3. Click **OK** to return to the Home screen.

Freeing Storage

To free or recover storage, delete documents and/or folders from the handheld. To keep the documents and folders for later use, transfer them to another handheld or to a computer using the TI-Nspire™ software.

Deleting Files from the Handheld

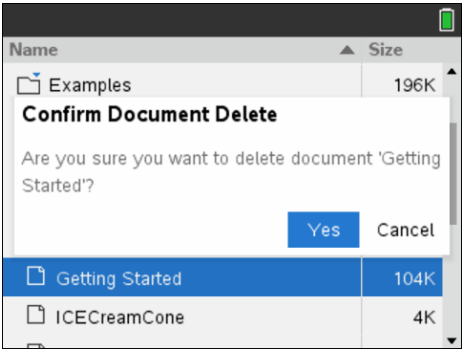
1. Press [on] [2] to open the **My Documents** file browser.
2. Press ▲ or ▼ to select the folder or document you want to delete.

3. Press del.

   —or—

   Press ctrl menu 6.

   A dialog box opens, asking you to confirm the deletion.



4. Press enter to confirm or esc to cancel.

   The folder/document is permanently removed from the handheld.

Backing up Files to Another Handheld

1. Connect the two handhelds using the USB-to-USB connectivity cable.
2. Press on 2 to open **My Documents** on the sending handheld.
3. Press the ▲ and ▼ keys to highlight the document you want to send.
4. Press menu, and then select **Send**.

   —or—

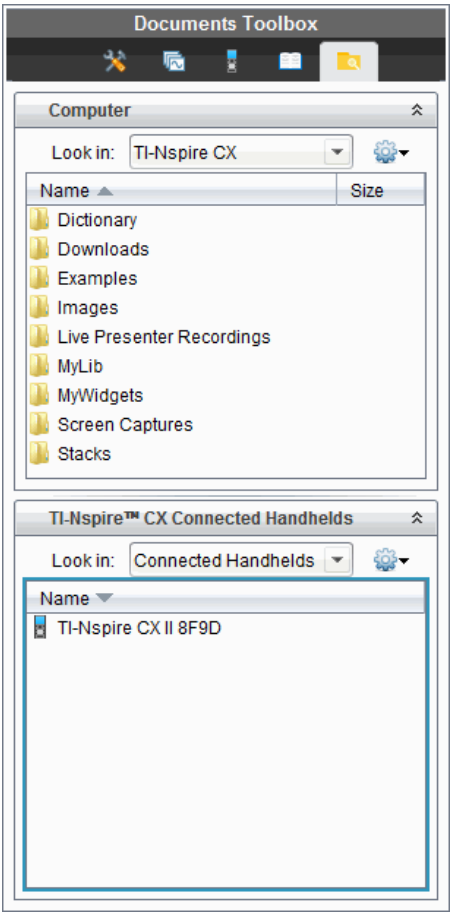
   Press ctrl menu 2.

5. When the file transfer is complete, a message is displayed on the receiving unit.

Transferring Files to a Computer

Use the TI-Nspire™ software to transfer files and folders from a handheld to a computer.

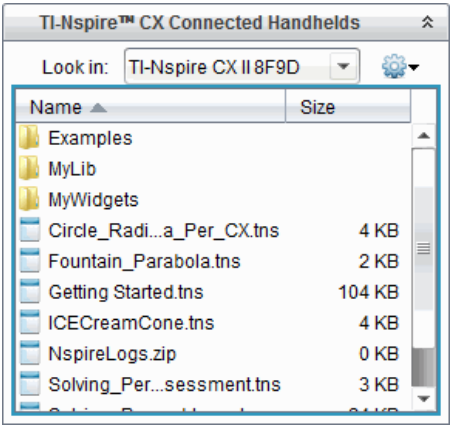
1. Connect your handheld to the computer using a standard A to mini-B USB cable.
2. In the TI-Nspire™ software, open the Documents Workspace.
3. In the Documents Toolbox, click to open the Content Explorer.



Computer pane

Connected Handhelds pane

4. In the Computer pane, navigate to the folder in which you want to save the files.
5. In the Connected Handhelds pane, double-click the handheld name to view the folders and files on the handheld.



6. Select the file or folder you want to save to the computer.
   - Click the file to select one file or folder at a time.
   - To select all files on the handheld, select the first file in the list, hold down the **Shift** key, and then click the last file or folder in the list.
   - To select random files, click the first file, and then hold the **Ctrl** key while selecting additional files.

   Note: If you select multiple files, it is saved as lesson bundle (.tilb file).

7. Drag the files to the folder in the Computer pane.

   —or—

   Select **File > Save as**.

   The files are copied to the folder on the computer.

8. Verify that the files you need are available on your computer, and then delete the files from the handheld.

Note: Those using the TI-Nspire™ CX Premium Teacher Software or the TI-Nspire™ CX Navigator™ Teacher Software can also use options in the Content Workspace to copy files from a handheld to a computer.

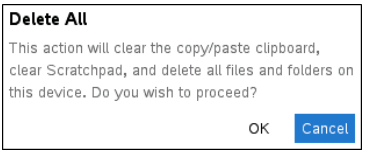
Resetting the Storage

Complete these steps only if you want to delete ALL files and folders on your handheld.

WARNING: This action clears the copy/paste clipboard, clears Scratchpad, and deletes all user-created files and folders from the handheld. You cannot undo this operation. Before proceeding, consider restoring sufficient available storage by deleting only selected data.

1. After making certain you want to clear all files, press [on] [2] to open the **My Documents** file browser.
2. Press [menu] to open the context menu.
3. Select **Delete All**.
   —or—
   Press [C].

   The Delete All dialog box opens.



4. Click **OK** to confirm that you want to clear the handheld storage.

Updating the Handheld Operating System

To take advantage of the latest handheld features and updates, download the latest operating system files from the Education Technology website (education.ti.com). You can update the operating system (OS) on TI-Nspire™ handhelds using a computer and the following software:

- TI-Nspire™ CX Premium Teacher Software (v5.0 and later)
- TI-Nspire™ CX Student Software (v5.0 and later)
- TI-Nspire™ CX CAS Premium Teacher Software (v5.0 and later)
- TI-Nspire™ CX CAS Student Software (v5.0 and later)
- TI-Nspire™ CX Navigator™ Teacher Software
- TI-Nspire™ CX CAS Navigator™ Teacher Software

In the classroom, you can use the TI-Nspire™ Docking Stations to upgrade the OS on multiple handhelds at the same time.

You can also transfer the OS from one TI-Nspire™ handheld to another or from one TI-Nspire™ CX II handheld to another. However, handheld operating systems are not interchangeable. You cannot transfer an Exact Arithmetic or CAS operating system to a non-Exact Arithmetic or non-CAS handheld and you cannot transfer a TI-Nspire™ handheld operating system to a TI-Nspire™ CX II handheld.

For web-based connectivity using your TI-Nspire™ CX II with a Chromebook, Windows® computer, or Mac® computer, go to TI-Nspire™ CX II Connect.

What You Need to Know

- If there is not enough room on the receiving handheld for the upgrade, a message is displayed. For more information, see *File Management*.
- OS upgrade operations do not delete user documents. The only time documents are affected by an OS installation is if the receiving handheld has a corrupted OS. In this situation, documents may be affected by OS restoration. It is a good practice to back up important documents and folders before installing an updated operating system.

Before You Begin

Before beginning an OS download, ensure that batteries are at least 25 percent charged.

▶ To check the status of the rechargeable battery in TI-Nspire™ CX II handhelds, press [on] [5] [4] to open the **Handheld Status** dialog box.

When in OS download mode, the Automatic Power Down™ (APD™) feature does not function. If you leave your handheld in download mode for an extended time before you begin the downloading process, your batteries may become depleted. You will then need to replace or recharge the batteries before downloading the OS.

Finding Operating System Updates

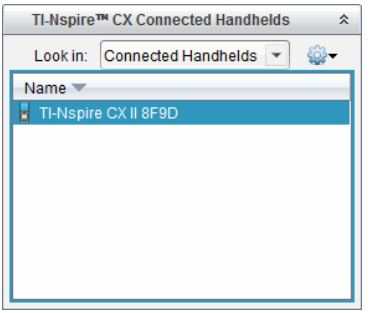
For up-to-date information about available OS upgrades, check the Texas Instruments website at education.ti.com.

You can download an OS upgrade from the Texas Instruments website to a computer, and use a USB cable to install the OS on your TI-Nspire™ CX II handheld. You will need an Internet connection and the appropriate USB cable to download the updates.

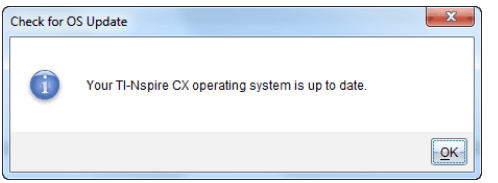
Checking for Handheld OS Updates

When using TI-Nspire™ software, you can quickly determine if your handheld OS is up to date when the handheld is connected to a computer.

1. Open the TI-Nspire™ software and ensure the handheld is connected to your computer.
2. In the Documents Workspace, click  to open Content Explorer.
3. In the Connected Handhelds pane, select a connected handheld.



4. Select **Help > Check for Handheld OS Update**.
   - If the operating system is current, the Check for Handheld OS Update dialog box opens indicating that the operating system on the handheld is up to date.



   - If the operating system is not current, the dialog box contains a message indicating that a new version of the operating system is available.
5. Click **OK** to close the dialog box.

Performing the OS Update

In the TI-Nspire™ software, you can select to upgrade the operating system on a connected handheld from the following workspaces and menus:

- In all versions of the software, you can select **Help > Check for Handheld/Lab Cradle OS Update**. Select a connected handheld in the Content Explorer to activate this option. If the OS on the handheld is not current, the dialog box indicates that there is an updated version of the operating system. Follow the prompts to update the operating system.
- In all versions of the TI-Nspire™ software, you can use options available in the Documents Workspace:
  - Open Content Explorer, select the handheld name, and then click  and select **Install OS**.

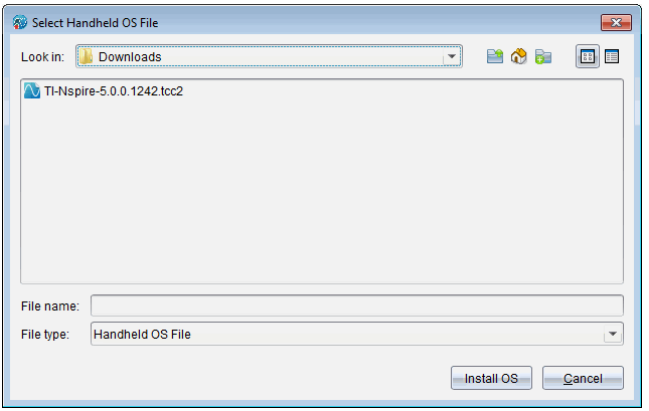
    —or—
  - Select **Tools > Install Handheld/Lab Cradle OS**.
- Those using teacher versions of the TI-Nspire™ software can use options available in the Content Workspace:
  - In the Resources pane, right-click the name of a connected handheld, and then select **Install Handheld/Lab Cradle OS**.

    —or—
  - Select the handheld name in the Preview pane, click  in the Preview pane, and then select **Install Handheld/Lab Cradle OS**.

    —or—
  - Right-click the handheld name and select **Install Handheld OS/Lab Cradle OS**.

Completing the OS Upgrade

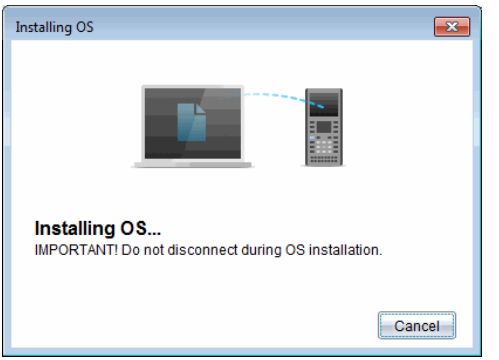
When you select to update the OS on a handheld, the Select Handheld OS File dialog box opens.



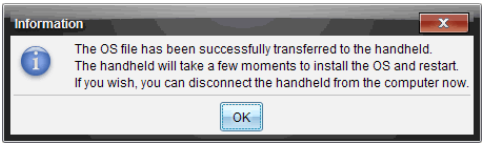
The file displayed for selection defaults to the file type required for the selected handheld.

1. Select the OS file:
   - If you are upgrading a TI-Nspire™ CX II handheld, select TI-Nspire.tco2
   - If you are upgrading a TI-Nspire™ CX II CAS handheld, select TI-Nspire.tcc2
   - If you are upgrading a TI-Nspire™ CX II-T (Exact Arithmetic) handheld, select TI-Nspire.tct2
2. Click **Install OS** to download the OS and update the handheld. The confirmation message "*You are about to upgrade your handheld operating system. Any unsaved data will be lost. Do you want to continue*?" is displayed.
3. Click **Yes** to continue.

   The Installing OS dialog box opens indicating the progress of the download. Do not disconnect the handheld.



4. When the download is complete, the Information dialog box opens indicating that the OS file has been successfully transferred to the handheld. You can disconnect the handheld.



5. Click **OK**.

   The updated operating system is installed on the handheld. When the update is complete, the handheld reboots.

6. On the handheld, follow the prompts to:
   - Choose a preferred language.
   - Select a preferred font size.
7. When the Welcome screen opens, click **OK**.

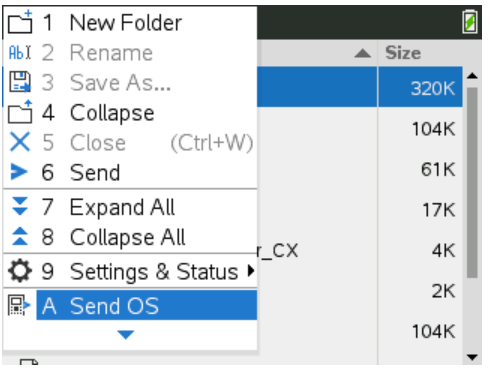
   The Home screen opens.

Transferring the Operating System From Another Handheld

Note: You cannot transfer the OS on a TI-Nspire™ handheld to a TI-Nspire™ CX II handheld and you cannot transfer the OS on an Exact Arithmetic or CAS handheld to a non-Exact Arithmetic or non-CAS handheld. The operating systems are not the same and are not interchangeable.

To transfer the OS from one handheld to another:

1. Ensure any open documents on the receiving handheld are closed.
2. Connect the two handhelds using a USB mini-A to mini-B USB cable.
3. On the sending handheld, select Browse from the Home screen.
4. Press menu, and then select **Send OS**.
   On a TI-Nspire™ handheld, press (menu).



5. On the receiving handheld, the message, "*You are receiving an OS Upgrade. Unsaved changes will be lost. Would you like to continue?*" is displayed along with Yes and No response buttons. Select Yes to receive the OS upgrade.
   - If **Yes** is not selected within 30 seconds, the handheld automatically responds with No, and the transmission is cancelled.
   - It is important to save and close all open documents before performing an OS Upgrade. Continuing with an OS Upgrade on a handheld with an open, unsaved document will cause the loss of that data.
6. While the upgrade is in progress, the following messages are displayed on the receiving and sending handhelds:
   - "*Receiving OS. Do not unplug cable.*"
   - "*Sending OS. Do not unplug cable.*"
7. After the transfer completes, the sending handheld receives a completion message and you can unhook the cable. The OS is automatically installed on the receiving handheld. During the installation process, the "*Installing OS <version number>*" message is displayed on the receiving handheld.
8. When the installation is complete, the "*OS <version number> has been installed. Handheld will now restart.*" message is displayed. The restart is initiated. If the sending handheld is still attached to the cable, the successful transmission message remains displayed on that handheld's screen.

Important:

- For each receiving handheld, remember to back up information as necessary and install new batteries.
- Be sure the sending handheld is on the **Send OS** screen.

Updating the OS on Multiple Handhelds

In the classroom, use the TI-Nspire™ CX Docking Station to upgrade the OS on multiple handhelds at the same time.

In the teacher versions of the TI-Nspire™ software, you can transfer files from the computer to multiple handhelds from the Content Workspace. See *Using the Content Workspace* for more information about transferring files to connected handhelds.

OS Upgrade Messages

This section lists the information and error messages that can be displayed on handhelds during an OS Upgrade.

Shown on:	Message and Description
Sending handheld	**"Receiver does not have enough storage space. Make <xxxK> available."**
	This message indicates that the receiving handheld does not have enough storage available for the new OS. The space requirement is

Shown on:	Message and Description
	shown so you know how much storage must be cleared for the new operating system. Files can be moved to a computer for storage to free the necessary space.
Sending handheld	**"Receiver must change batteries before upgrading the OS."**
	This message indicates that the batteries in the receiving handheld need to be replaced. Send the OS Upgrade once the batteries are replaced.
Sending handheld	**"Receiver has a newer OS and cannot load this OS."** **OK**
	This message indicates that the receiving handheld has a newer OS version than the one being transmitted. You cannot downgrade an OS.
Sending handheld	**"Upgrade not accepted by receiver."** **OK**
	This message indicates that the receiving handheld refuses the upgrade.
Sending handheld	**"OS has been transferred. You can now unplug."** **OK**
	This message indicates that the transfer is complete and it is safe to unplug the cable from the sending handheld.
Sending handheld	**"Sending OS. Do not unplug cable."**
	This message, along with a progress bar, is displayed while the OS Upgrade is being transferred.
Both handhelds	**"Transfer failed. Check cable and try again."** **OK**
	The sending and/or receiving handheld is not properly connected. Reinsert the cable into each handheld, and then try the transmission again.
Receiving handheld	**"You are receiving an OS Upgrade. Unsaved changes will be lost. Would you like to continue?"** **Yes No**

Shown on:	Message and Description
	This message is displayed when an OS Upgrade is about to begin. If you do not select Yes within 30 seconds, the system automatically responds with No.
Receiving handheld	**"Receiving OS. Do not unplug cable."**
	This message, along with a progress bar, is displayed while the OS Upgrade is being transferred.
Receiving handheld	**"Installing OS."**
	This message is displayed when the transfer is complete. It is shown to keep you informed of the handheld's status.
Receiving handheld	**"OS has been installed. Handheld will restart."** **OK**
	This information message displays briefly before the handheld automatically reboots.
Receiving handheld	**"Install was corrupted. Handheld will reboot. You will need to retry OS upgrade."** **OK**
	An error occurred during the transmission and the installation was corrupted. The handheld will reboot. After the reboot, reinstall the OS Upgrade.

TI-Nspire™ CX II Connect

TI-Nspire™ CX II Connect is a web-based app that provides connectivity between a computer and a TI-Nspire™ CX II graphing calculator. It allows you to capture the calculator screen, transfer .tns files to and from the calculator, and update the OS on the calculator.

System Requirements

- Active internet connection
- Web USB enabled
- Access to shared memory, files, and clipboard

Note: For the latest hardware, operating system, browser, and other requirements, please visit the product page.

Supported Calculators

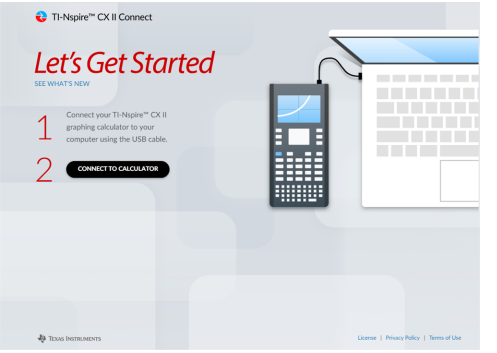
- TI-Nspire™ CX II
- TI-Nspire™ CX II CAS
- TI-Nspire™ CX II-T
- TI-Nspire™ CX II-T CAS
- TI-Nspire™ CX II-C CAS

Getting Started with TI-Nspire™ CX II Connect

1. Open a compatible browser.
2. Enter **nspireconnect.ti.com** into the address bar.

   If prompted, click **Agree and Proceed** to accept cookies, and then click **ACCEPT** button to agree with the TI terms and conditions.

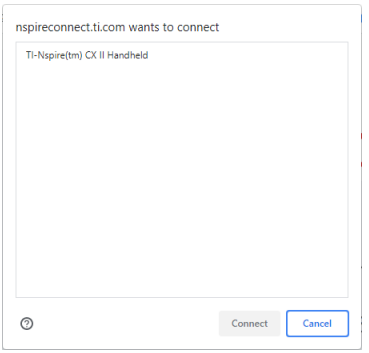
   A compatibility check will be performed while the app loads. If any issues are found, a page will display with information on what needs to be addressed.



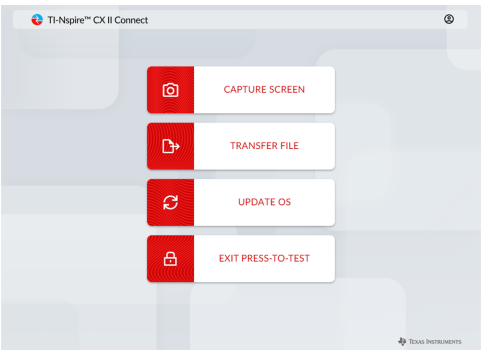
3. After the Let's Get Started page loads, connect your TI-Nspire™ CX II calculator to your computer.

   Note: If your computer only has a USB-C port, you will need a USB-A to USB-C adapter to connect your calculator.

4. Click **CONNECT TO CALCULATOR**.
5. On the popup window, click the name of your calculator and then click **Connect**.



The home page will open displaying the four available options: Capture Screen, Transfer File, Update OS, and Exit Press-to-Test.



Navigating on the app

There are two ways to navigate on the TI-Nspire™ CX II Connect app after connecting your calculator:

- TI-Nspire™ CX II Connect logo on the top left of each page which links to the home page
- Links to each function on the top right of each page except the home and Let's Get Started pages

Note: If your calculator is disconnected and then reconnected (or you connect another calculator), you will be redirected to the Let's Get Started page.

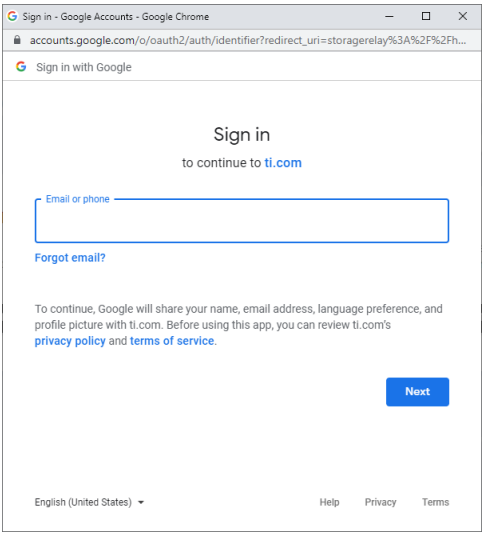
Using Google Drive

Note: This feature is optional. TI does not save any of your user data if you sign in with Google.

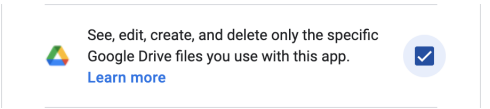
To use your Google Drive account to save screenshots or transfer .tns files

1. Click the **Sign in with Google** icon on the top right part of any page.

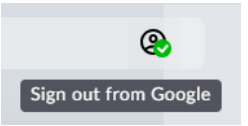
2. On the **Sign in with Google** popup window, complete the sign in process to connect to Google Drive.



3. When prompted on the standard Google Account dialog, select the checkbox for the option to grant the app access to your Google Drive for transferring files to or from your computer.



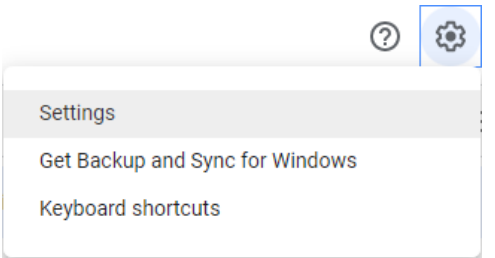
After signing successfully, the sign in icon will have a green checkmark and can then be used to sign out of your Google Drive account.



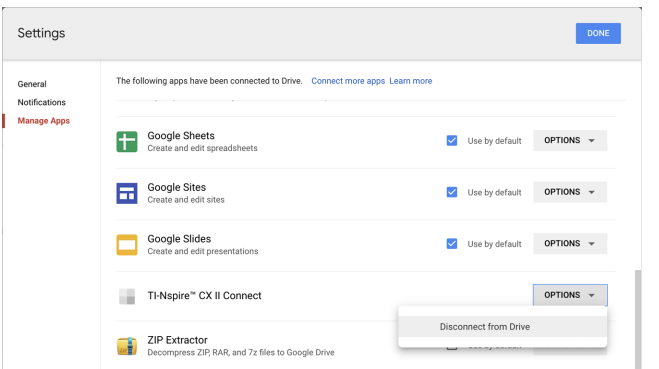
Note: When using Google Drive for screen captures or file transfers, you must create the folder(s) you want to use in Google Drive first.

Disconnecting TI-Nspire™ CX II Connect from Google Drive

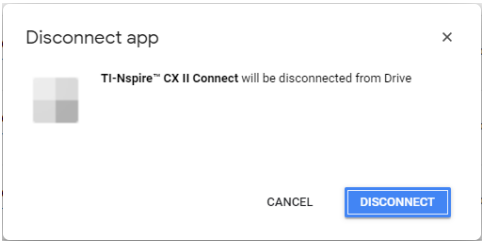
1. In Google Drive, click the settings icon and select **Settings**.



2. On the **Settings** dialog, click **Manage Apps**.
3. Locate the TI-Nspire CX II Connect app in the list and then click **OPTIONS > Disconnect from Drive**.



4. On the confirmation dialog, click **DISCONNECT**.



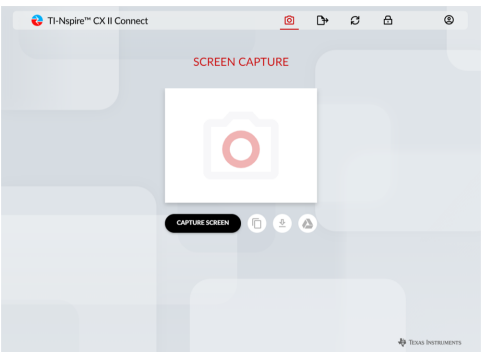
The TI-Nspire™ CX II Connect app will be removed from the list.

5. Click **DONE**.

Capturing the Calculator Screen

To capture the calculator screen

1. Navigate to the **SCREEN CAPTURE** page.



2. Click the **CAPTURE SCREEN** button.

   The current calculator screen will display.

   Note: To capture another screen, make the necessary changes on the calculator and click the **CAPTURE SCREEN** button again.

3. Click one of the following buttons:

   - Copies the current screen to the computer clipboard and use the image in other apps.

   - Saves the current screen to your computer.

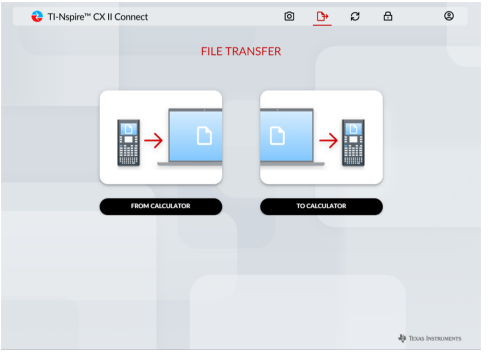
   - Saves the current screen to Google Drive.

   Note: When using Google Drive for screen captures or file transfers, you must create the folder(s) you want to use in Google Drive first.

Transferring Files

To transfer files to or from the computer

1. Navigate to the **FILE TRANSFER** page.



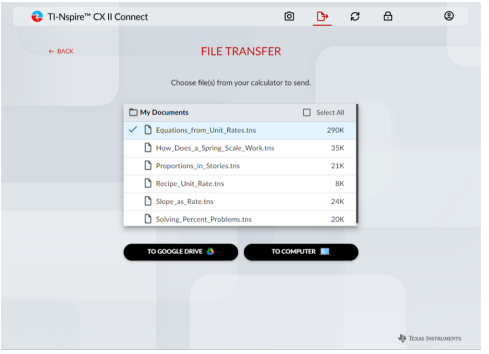
2. Click either **FROM CALCULATOR** or **TO CALCULATOR** and follow the corresponding instructions below.

   Note: Only .tns files can be transferred. Other file types will not be shown. Also, files on the calculator must be in the My Documents folder, not a sub folder.

Transferring files from the calculator to the computer

Choose the file(s) from the My Documents folder on the calculator that you want to send to the computer.

Note: Check or uncheck the **Select All** box to highlight or clear the selection of all files.



To transfer files to Google Drive

1. Click **TO GOOGLE DRIVE**.

2. Click on the folder you want to save the files to and click **Select**.

   Note: When using Google Drive for screen captures or file transfers, you must create the folder(s) you want to use in Google Drive first.

   Note: If you transfer files that already exist on Google Drive, they will be automatically overwritten.

3. When the **Files Sent** list appears, you can click **SEND MORE FILES** or the **BACK** link to select more files to transfer.

To transfer files to the computer

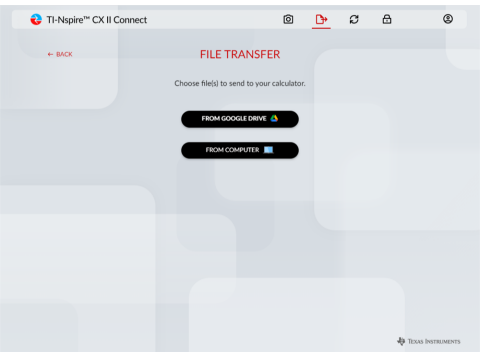
1. Click **TO COMPUTER**.
2. Click on the folder you want to save the files to and click **Select Folder**.
3. When prompted to let the site view files, click **View files**.
4. When prompted to save changes to the destination folder, click **Save changes**.

   Note: If you transfer files that already exist on the computer, a copy of the file will be created with a number appended to the file name.

5. When the **Files Sent** list appears, you can click **SEND MORE FILES** or the **BACK** link to select more files to transfer.

Transferring files from the computer to the calculator

1. Click either **FROM GOOGLE DRIVE** or **FROM COMPUTER**.



2. Locate and select the file(s) to transfer.

   Note: If you transfer files that already exist on the calculator, a copy of the file will be created with a number appended to the file name.

3. When the **Files Sent** list appears, you can click **SEND MORE FILES** or the **BACK** link to select more files to transfer.

   Note: If you transfer files that already exist on the calculator, a copy of the file will be created with a number appended to the file name.

4. On the calculator a prompt will display with the following options:

   Open - Opens the file that was transferred.

   Go To - Opens the My Documents folder and highlights the file that was transferred.

   OK - Clears the prompt.

   Note: If you transfer multiple files the prompt will only apply to the last file that was transferred.

File Transfer Troubleshooting

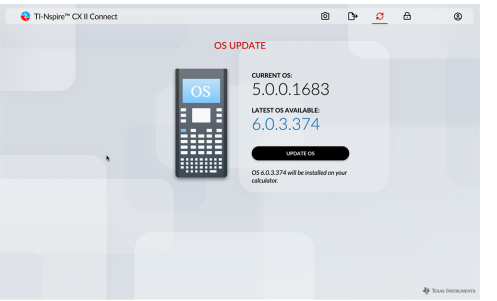
- Sending .tns files to and from nested folders on a calculator is not supported. The .tns file must be in the calculator My Documents folder in order to access the file.
- If a "Location not available." message appears when transferring .tns file to a computer or network location, this is because sending files to a location that contains system files is not supported (e.g. C:\, C:\Desktop, etc.). To avoid this, create a new folder or choose a different folder to transfer your files.

Updating the OS

To update the OS on the calculator

1. Navigate to the **OS UPDATE** page.

   The app will check the OS version on the calculator. If there is a newer version available, you will be prompted to update.



2. Click the **UPDATE OS** button.

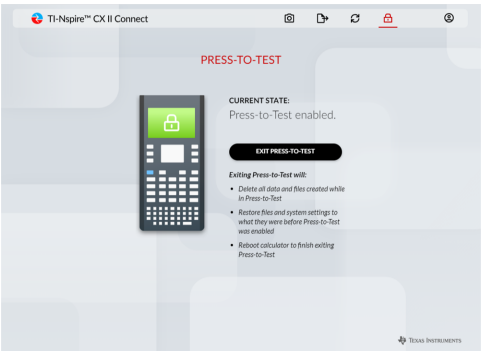
   A confirmation message will appear when the update is finished.

Exiting Press-to-Test

To exit Press-to-Test on the calculator

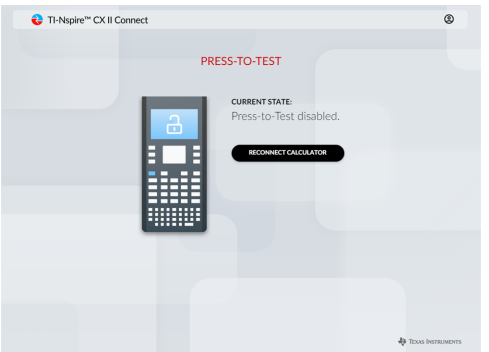
1. Navigate to the **PRESS-TO-TEST** page.

   The app will check the Press-to-Test state of the calculator. If Press-to-Test is enabled, you will be prompted to exit.



2. Click the **EXIT PRESS-TO-TEST** button.

   A confirmation message will appear when Press-to-Test has been disabled. Click **RECONNECT CALCULATOR** if you need to reconnect.



Calculator Application

The Calculator application lets you:

- Enter and evaluate math expressions
- Define variables, functions, and programs that become available to any TI-Nspire™ application—such as the Graphs application—residing in the same problem.
- Define library objects, such as variables, functions, and programs, which are accessible from any problem of any document. For information on creating library objects, see *Libraries*.

Adding a Calculator Page

▶ To start a new document with a blank Calculator page:

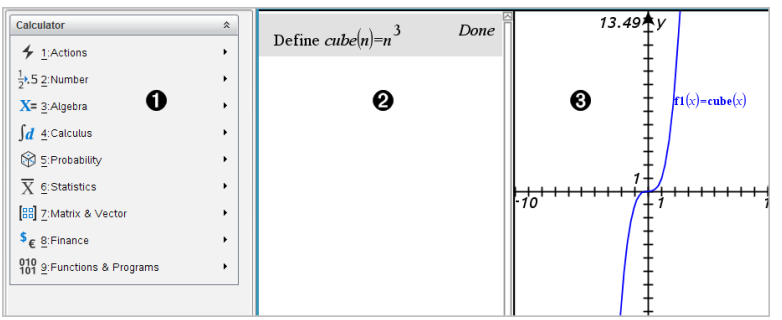
From the main **File** menu, click **New Document**, and then click **Add Calculator**.

Handheld: Press [on], and select **Calculator**.

▶ To add a Calculator page in the current problem of an existing document:

From the toolbar, click **Insert > Calculator**.

Handheld: Press [doc] and select **Insert > Calculator**.



❶ **Calculator menu.** This menu is available anytime you are in the Calculator work area using the Normal view mode. The menu in this screen snapshot may not exactly match the menu on your screen.

❷ **Calculator work area**

- Enter a math expression on the entry line, and then press **Enter** to evaluate the expression.
- Expressions are displayed in standard mathematical notation as you enter them.
- Entered expressions and results show in the Calculator history.

❸ Example of Calculator variables used in another application.

Entering and Evaluating Math Expressions

Entering Simple Math Expressions

Note: To enter a negative number on the handheld, press (−). To enter a negative number on a computer keyboard, press the hyphen key (-).

Suppose you want to evaluate $\frac{2^8 \cdot 43}{12}$

1. Select the entry line in the Calculator work area.
2. Type **2^8** to begin the expression.

3. Press ► to return the cursor to the baseline.
4. Complete the expression:

   Type ***43/12**.

   Handheld: Type (×) **43** (÷) **12**.

5. Press **Enter** to evaluate the expression.

   The expression is displayed in standard mathematical notation, and the result is displayed on the right side of the Calculator.

Note: If a result does not fit on the same line with the expression, it is displayed on the next line.

Controlling the Form of a Result

You might expect to see a decimal result instead of 2752⁄3 in the preceding example. A close decimal equivalent is 917.33333..., but that's only an approximation.

By default, Calculator retains the more precise form: 2752⁄3. Any result that is not a whole number is shown in a fractional or exact (Exact Arithmetic and CAS) form, or symbolic form (CAS). This reduces rounding errors that could be introduced by intermediate results in chained calculations.

You can force a decimal approximation in a result:

- By pressing shortcut keys.

  Windows®: Press **Ctrl+Enter** to evaluate the expression.

  Mac®: Press **⌘+Enter** to evaluate the expression.

  Handheld: Press ctrl enter instead of enter to evaluate the expression.

  Pressing ctrl enter forces the approximate result.

- By including a decimal in the expression (for example, **43.** instead of **43**).

- By wrapping the expression in the **approx()** function.

- By changing the document's **Auto or Approximate** mode setting to Approximate.

  From the **File** menu, click **Settings > Document Settings**.

  Handheld: Press doc to display the **File** menu.

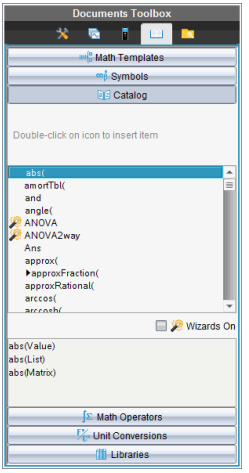
  Note that this method forces all results in all of the document's problems to approximate.

Inserting Items from the Catalog

You can use the Catalog to insert system functions and commands, symbols, and expression templates into the Calculator entry line.

1. Click the **Utilities** tab, and then click to open the Catalog.

   Handheld: Press **1**.



Note: Some functions have a wizard that prompts you for each argument. Those functions are shown with an indicator. To receive the prompts, select Wizards On.

2. If the item you are inserting is visible in the list, select it and press **Enter** to insert it.
3. If the item is not visible:
   a) Click inside the list of functions, and then press a letter key to jump to the entries that begin with that letter.
   b) Press ▲ or ▼ as necessary to highlight the item you are inserting.

      Help, such as syntax information or a short description of the selected item, appears at the bottom of the Catalog.

   c) Press **Enter** to insert the item into the entry line.

Using an Expression Template

The Calculator has templates for entering matrices, piecewise functions, systems of equations, integrals, derivatives, products, and other math expressions.

For example, suppose you want to evaluate $\sum_{n=3}^{7}(n)$

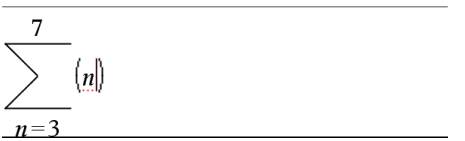
1. On the **Utilities** tab, click to open the templates.

Handheld: Press [menu].

2. Double-click [Σ] to insert the algebraic sum template.

   The template appears on the entry line with small blocks representing elements that you can enter. A cursor appears next to one of the elements to show that you can type a value for that element.

3. Use the arrow keys to move the cursor to each element's position, and type a value or expression for each element.



4. Press **Enter** to evaluate the expression.

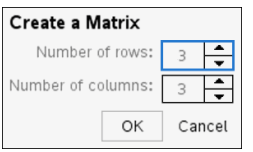
Creating Matrices

1. On the **Utilities** tab, click [matrix] to open the templates.

   Handheld: Press [menu].

2. Double-click [matrix].

   The Create a Matrix dialog box opens.



3. Type the **Number of rows**.

4. Type the **Number of columns**, and then click **OK**.

   Calculator opens a template with spaces for the rows and columns.

   Note: If you create a matrix with a large number of rows and columns, it may take a few moments to appear.

5. Type the matrix values into the template, and then press **Enter** to define the matrix.

Inserting a Row or Column into a Matrix

▶ To insert a new row, hold down **Alt** and press **Enter**.

▶ To insert a new column, hold down **Shift** and press **Enter**.

Handheld:

▶ To insert a new row, press ↵.

▶ To insert a new column, press **Shift+Enter**.

Inserting Expressions Using a Wizard

You can use a wizard to simplify entering some expressions. The wizard contains labeled boxes to help you enter the arguments in the expression.

For example, suppose you want to fit a $y = mx + b$ linear regression model to the following two lists:

{1,2,3,4,5}
{5,8,11,14,17}

1. On the **Utilities** tab, click to open the Catalog.

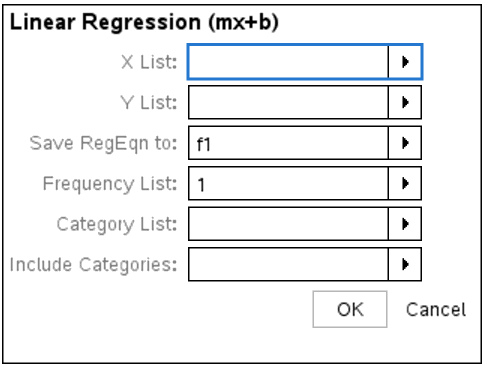
   Handheld: Press **1**.

2. Click an entry in the Catalog, and then press **L** to jump to the entries that begin with "L."
3. Press ▼ as necessary to highlight **LinRegMx**.
4. Select the **Wizards On** option, if it is not already selected:

   Handheld: Press **Tab Tab** to highlight **Wizards On**, press **Enter** to change the setting, and then press **Tab Tab** to highlight **LinRegMx** again.

5. Press **Enter**.

   A wizard opens, giving you a labeled box to type each argument.



6. Type {**1,2,3,4,5**} as **X List**.
7. Press **Tab** to move to the **Y List** box.
8. Type **{5,8,11,14,17}** as **Y List**.
9. If you want to store the regression equation in a specific variable, press **Tab**, and then replace **Save RegEqn To** with the name of the variable.
10. Click **OK** to close the wizard and insert the expression into the entry line.

    Calculator inserts the expression and adds statements to copy the regression equation and show the variable *stat.results*, which will contain the results.

    LinRegMx {1,2,3,4,5},{5,8,11,14,17},1: CopyVar stat.RegEqn,f2: stat.results

    Calculator then shows the *stat.results* variables.

$$\text{LinRegMx } \{1,2,3,4,5\},\{5,8,11,14,17\},1:\ stat.results$$

"Title"	"Linear Regression (mx+b)"
"RegEqn"	"m*x+b"
"m"	3.
"b"	2.
"r^2"	1.
"r"	1.
"Resid"	"{...}"

Note: You can copy values from the *stat.results* variables and paste them into the entry line.

Creating a Piecewise Function

1. Begin the function definition. For example, type the following expression:

`Define f(x,y)=`

2. On the **Utilities** tab, click to open the templates.

   Handheld: Press .

3. Double-click .

   The Create Piecewise Function dialog box opens.

4. Type the **Number of Function Pieces**, and click **OK**.

   Calculator opens a template with spaces for the pieces.

5. Type the expressions into the template, and press **Enter** to define the function.

6. Enter an expression to evaluate or graph the function. For example, type the expression `f(1,2)` on the Calculator entry line.

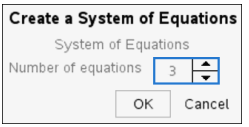
Creating a System of Equations

1. On the **Utilities** tab, click to open the templates.

   Handheld: Press .

2. Double-click .

   The Create a System of Equations dialog box opens.



3. Type the **Number of Equations**, and click **OK**.

   Calculator opens a template with spaces for the equations.

4. Type the equations into the template, and press **Enter** to define the system of equations.

Entering Multiple Statements on the Entry Line

To enter several statements on a single line, separate them with a colon (":"). Only the result of the last expression is shown.

$a:=5:\ b:=2:\ \frac{a}{b}\cdot 1.$ 2.5

CAS: Working with Measurement Units

A list of pre-defined constants and measurement units is available in the Catalog. You can also create your own units.

Note: If you know a unit's name, you can type the unit directly. For example, you can type `_qt` to specify quarts. To type the underscore symbol on the handheld, press ctrl ␣.

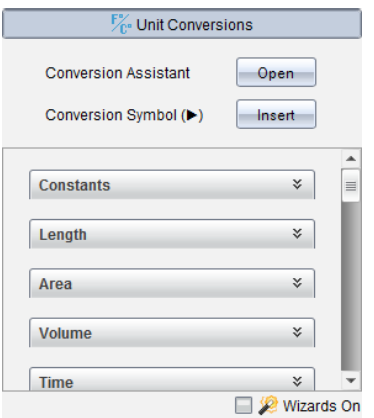
CAS: Converting Between Measurement Units

You can convert a value between any two units within the same category (such as length).

Example: Using the Catalog, convert 12 meters to feet. The desired expression is 12•_m▶_ft.

1. Type **12** on the entry line.
2. On the **Utilities** tab, click F°C° to show the unit conversions.

   Handheld: Press 🕮 **3**.

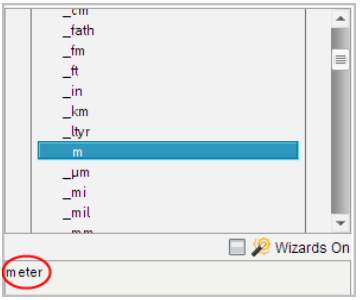


3. Click the **Length** category to expand the list of pre-defined length units.

   Handheld: Scroll to the **Length** category, and press **Enter**.

4. Scroll to **meter**.

   Handheld: Scroll to **_m** (noting the **meter** hint in the Help window).



5. Press **Enter** to paste **_m** to the entry line.

6. Click the Conversion Operator (▶) at the top of the Units list, and press **Enter** to paste it to the entry line.

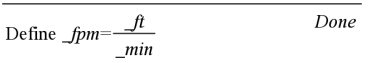
7. Select **_ft** from the Length category, and press **Enter**.

8. Press **Enter** to evaluate the expression.

CAS: Creating a User-defined Unit

As with the pre-defined units, user-defined unit names must begin with an underscore symbol.

Example: Using the pre-defined units *_ft* and *_min*, define a unit named *_fpm* that lets you enter velocity values in feet per minute and convert velocity results to feet per minute.



Now you can use the new velocity unit _*fpm*.

15·_*knot*▶_*fpm*	1519.03·_*fpm*
160·_*mph*▶_*fpm*	14080.·_*fpm*
500·_*fpm*▶_*knot*	4.93737·_*knot*

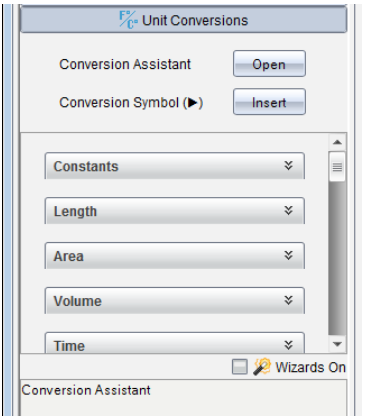
Using the Unit Conversion Assistant

In any application where math input is allowed, you can generate unit conversions using the Unit Conversion Assistant. This can help reduce syntax errors by automatically entering the units for you.

Example: Convert 528 minutes to hours. The desired expression is 528•_min▶_hr.

1. Type **528** on the entry line.
2. On the **Utilities** tab, click the **Unit Conversions** bar.

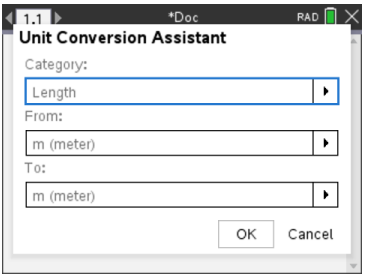
   Handheld: Press [doc] 3.



3. Click the **Open** button next to **Conversion Assistant**.

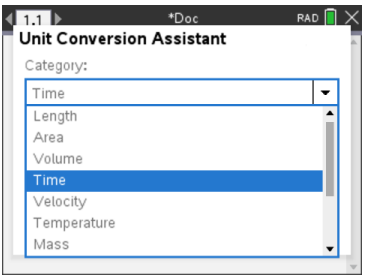
   Handheld: Press enter.

   The **Unit Conversion Assistant** dialog box displays:



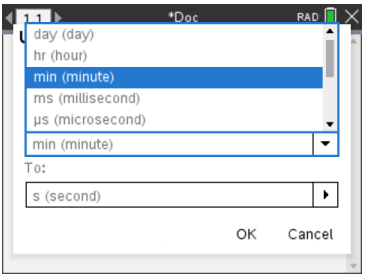
4. Click the **Category** list and select **Time**.

   Handheld: Scroll to the **Time** category and press enter.



5. Click the **From** list and select **min (minute)**.

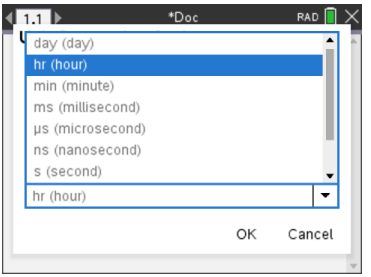
   Handheld: Scroll to **min (minute)** and press enter.



   Note: You can select **Use existing unit** at the bottom of the list if you have already entered a unit. In this example, you might have already entered 528•_min.

6. Click the **To** list and select **hr (hour)**.

   Handheld: Scroll to **hr (hour)** and press enter.



7. Click **OK** to paste **_min▶_hr** to the entry line.
8. Press **Enter** to evaluate the expression.

   Handheld: Press enter.

Note:

- The last Category, From, and To selections will be retained until:
  - the software is closed and re-opened (Desktop)
  - the device is reset (Handheld)
  - the language is changed, or the app is uninstalled or upgraded (iPad)
- Inserting a conversion into a Notes text field will automatically create a Math Box.
- Inserting a conversion into an empty line in the Calculator will automatically insert **Ans** before the conversion.

Working with Variables

When you first store a value in a variable, you give the variable a name.

- If the variable does not already exist, Calculator creates it.
- If the variable already exists, Calculator updates it.

Variables within a problem are shared by TI-Nspire™ applications. For example, you can create a variable in Calculator and then use or modify it in Graphs & Geometry or Lists & Spreadsheet within the same problem.

For more information, see *Using Variables*.

Creating User-defined Functions and Programs

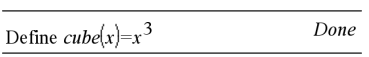
You can use the **Define** command to create your own functions and programs. You can create them in the Calculator application or in the Program Editor and then use them in other TI-Nspire™ applications.

For more information, see *Overview of the Program Editor* and *Libraries*.

Defining a Single-line Function

Suppose you want to define a function named **cube()** that calculates the cube of a number or variable.

1. On the Calculator entry line, type **`Define cube(x)=x^3`** and press **Enter**.



   The message "Done" confirms that the function has been defined.

2. Type **`cube(2)`** and press **Enter** to test the function.

Defining a Multiple-line Function Using Templates

You can define a function consisting of multiple statements entered on separate lines. A multiple-line function may be easier to read than one with multiple statements separated by colons.

Note: You can create multiple-line functions only by using the **Define** command. You cannot use the **:=** or → operators to create multiple-line definitions. The **Func...EndFunc** template serves as a container for the statements.

As an example, define a function named **g(***x*,*y***)** that compares two arguments x and y. If argument x > argument y, the function should return the value of x. Otherwise, it should return the value of y.

1. On the Calculator entry line, type **`Define g(x,y)=`**. Do not press **Enter** yet.

2. Insert the **Func...EndFunc** template.

   From the **Functions & Programs** menu, select **Func...EndFunc**.

   Calculator inserts the template.

```
define g(x,y)=Func
                |
              EndFunc
```

3. Insert the **If...Then...Else...EndIf** template.

   From the **Functions & Programs** menu, select **Control**, and then select **If...Then...Else...EndIf**.

   Calculator inserts the template.

```
define g(x,y)=Func
                If | Then

                  Else

                  EndIf
              EndFunc
```

4. Type the remaining parts of the function, using the arrow keys to move the cursor from line to line.

```
define g(x,y)=Func
                If x>y Then
                  return x
                Else
                  return y
                EndIf
              EndFunc
```

5. Press **Enter** to complete the definition.
6. Evaluate **`g(3,-7)`** to test the function.

```
g(3,-7)                                    3
```

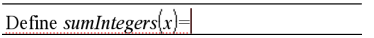
Defining a Multiple-line Function Manually

Within a multi-line template such as **Func...EndFunc** or **If...EndIf**, you can start a new line without completing the definition.

- **Handheld:** Press ↵ instead of enter.
- **Windows®:** Hold **Alt** and press **Enter**.
- **Macintosh®:** Hold **Option** and press **Enter**.

As an example, define a function **sumIntegers(*x*)** that calculates the cumulative sum of integers from 1 through *x*.

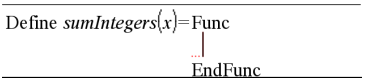
1. On the Calculator entry line, type **`Define sumIntegers(x)=`**. Do not press **Enter** yet.



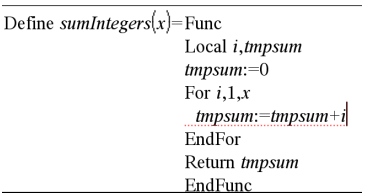
2. Insert the **Func...EndFunc** template.

   From the **Functions & Programs** menu, select **Func...EndFunc**.

   Calculator inserts the template.



3. Type the following lines, pressing ↵ or **Alt+Enter** at the end of each line.



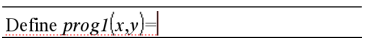
4. After typing **`Return tmpsum`**, press **Enter** to complete the definition.
5. Evaluate **`sumIntegers(5)`** to test the function.

Defining a Program

Defining a program is similar to defining a multiple-line function. The **Prgm...EndPrgm** template serves as a container for the program statements.

As an example, create a program named **g(***x*,*y***)** that compares two arguments. Based on the comparison, the program should show the text "$x>y$" or "$x\leq y$" (showing the values of x and y in the text).

1. On the Calculator entry line, type **`Define prog1(x,y)=`**. Do not press **Enter** yet.



2. Insert the **Prgm...EndPrgm** template.

   From the **Functions & Programs** menu, select **Prgm...EndPrgm**.

```
Define prog1(x,y)=Prgm
                  
                EndPrgm
```

3. Insert the **If...Then...Else...EndIf** template.

   From the **Functions & Programs** menu, select **Control**, and then select **If...Then...Else...EndIf**.

```
Define prog1(x,y)=Prgm
                If  Then

                Else

                EndIf
                EndPrgm
```

4. Type the remaining parts of the function, using the arrow keys to move the cursor from line to line. Use the Symbol Palette to select the "≤" symbol.

```
Define prog1(x,y)=Prgm
                If x>y Then
                  Disp x," > ",y
                Else
                  Disp x," ≤ ",y
                EndIf
                EndPrgm
```

5. Press **Enter** to complete the definition.
6. Execute **`prog1(3,-7)`** to test the program.

```
prog1(3,-7)
                                3 > -7
                                Done
```

Recalling a Function or Program Definition

You might want to reuse or modify a function or program that you have defined.

1. Show the list of defined functions.

   From the **Actions** menu, select **Recall Definition**.

2. Select the name from the list.

   The definition (for example, **`Define f(x)=1/x+3`**) is pasted into the entry line for editing.

Editing Calculator Expressions

Although you cannot edit an expression in the Calculator history, you can copy all or part of an expression from the history and paste it to the entry line. You can then edit the entry line.

Positioning the Cursor in an Expression

- Press **Tab**, ◄, ►, ▲, or ▼ to move the cursor through the expression. The cursor moves to the closest valid position in the direction that you press.

Note: An expression template may force the cursor to move through its parameters, even though some parameters may not be exactly in the path of the cursor movement. For example, moving upward from the main argument of an integral always moves the cursor to the top limit.

Inserting into an Expression in the Entry Line

1. Position the cursor at the point where you want to insert additional elements.
2. Type the elements that you want to insert.

Note: When you insert an open parenthesis, Calculator adds a temporary close parenthesis, displayed in gray. You can override the temporary parenthesis by typing the same parenthesis manually or by entering something past the temporary parenthesis (thereby implicitly validating its position in the expression). After you override the temporary gray parenthesis, it is replaced with a black parenthesis.

Selecting Part of an Expression

1. Position the cursor at the starting point in the expression.

   Handheld: Press ◄, ►, ▲, or ▼ to move the cursor.
2. Press and hold **Shift**, and then press ◄, ►, ▲, or ▼ to select.

Deleting all or part of an expression on the entry line

1. Select the part of the expression to delete.
2. Press **Del**.

Financial Calculations

Several TI-Nspire™ functions provide financial calculations, such as time value of money, amortization calculations, and return on investment calculations.

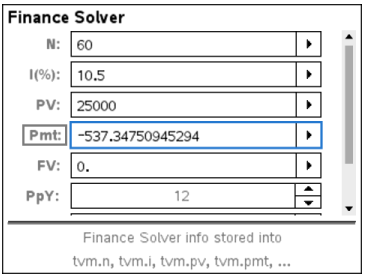
The Calculator application also includes a Finance Solver. It lets you dynamically solve several types of problems, such as loans and investments.

Using the Finance Solver

1. Open the Finance Solver.

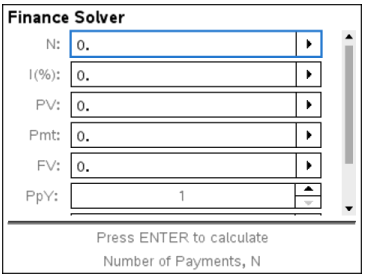
   From the **Finance** menu, click **Finance Solver**.

   The Finance Solver displays its default values (or previous values, if you have already used the solver in the current problem).



2. Enter each known value, using **Tab** to cycle through the items.
   - The help information at the bottom of the Finance Solver describes each item.
   - You might need to temporarily skip the value that you want to calculate.
   - Make sure to set **PpY**, **CpY**, and **PmtAt** to the correct settings (12, 12, and END in this example).
3. Press **Tab** as necessary to select the item that you want to calculate, and then press **Enter**.

   The Finance Solver calculates the value and stores all the values in "tvm." variables, such as *tvm.n* and *tvm.pmt*. These variables are accessible to all TI-Nspire™ applications within the same problem.



Finance Functions Included

In addition to the Finance Solver, TI-Nspire™ built-in finance functions include:

- TVM functions for calculating future value, present value, number of payments, interest rate, and payment amount.

- Amortization information such as amortization tables, balance, sum of interest payments, and sum of principal payments.
- Net present value, internal rate of return, and modified rate of return.
- Conversions between nominal and effective interest rates, and calculation of days between dates.

Notes:

- Finance functions do not automatically store their argument values or results to the TVM variables.
- For a complete list of TI-Nspire™ functions, see the *Reference Guide*.

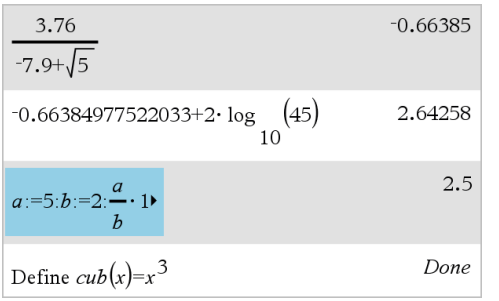
Working with the Calculator History

As you enter and evaluate expressions in the Calculator application, each entry/result pair is saved in the Calculator history. The history gives you a way to review your calculations, repeat a set of calculations, and copy expressions for reuse in other pages or documents.

Viewing the Calculator History

Note: You may notice a processing slowdown when the history contains a large number of entries.

▶ Press ▲ or ▼ to scroll through the history.



Copying a Calculator History Item to the Entry Line

You can quickly copy an expression, subexpression, or result from the history into the entry line.

1. Press ▲ or ▼ to move through the history and select the item that you want to copy.

   —or—

Select part of the expression or result by using **Shift** in combination with the arrow keys.

Note: The float setting for the current document may limit the number of decimal places displayed in a result. To capture the result in its full precision, select it either by scrolling with the up and down arrow keys or by triple-clicking it.

2. Press **Enter** to copy the selection and insert it into the entry line.

Copying a History Item to Another Application

1. Press ▲ or ▼ to move through the history and select the item that you want to copy.
2. Optionally, select part of the expression or result by pressing **Shift** in combination with the arrow keys.
3. Use the standard key shortcut for copying a selection.

   Windows®: Press **Ctrl+C**.

   Mac®: Press **⌘+C**.

   Handheld: Press ctrl C.
4. Place the cursor at the location where you want the copy.
5. Paste the copy.

   Windows®: Press **Ctrl+V**.

   Mac®: Press **⌘+V**.

   Handheld: Press ctrl V.

Note: If you copy an expression that uses variables into a different problem, the values of those variables are not copied. You must define the variables in the problem where you paste the expression.

Deleting an Expression from the History

When you delete an expression, all variables and functions defined in the expression retain their current values.

1. Drag or use the arrow keys to select the expression.

   Handheld: Use the arrow keys.

2. Press **Del**.

   The expression and its result are removed.

Clearing the Calculator History

When you clear the history, all variables and functions defined in the history retain their current values. If you clear the history by mistake, use the undo feature.

▶ From the **Actions** menu, select **Clear History**.

All expressions and results are removed from the history.

Data Collection

The Vernier DataQuest™ application is built into the TI-Nspire™ software and the operating system (OS) for handhelds. The application lets you:

- Capture, view, and analyze real-world data using a TI-Nspire™ CX II handheld, a Windows® computer, or a Mac® computer.
- Collect data from up to four Bluetooth connected Vernier Go Direct® sensors using a TI Bluetooth® Adapter.
- Collect data from up to five connected sensors (three analog and two digital) using the TI-Nspire™ Lab Cradle.

  Important: The TI-Nspire™ CM-C Handheld is not compatible with the Lab Cradle and only supports the use of a single sensor at a time.
- Collect data either in the classroom or at remote locations using collection modes such as time-based or event-based.
- Collect several data runs for comparison.
- Create a graphical hypothesis using the Draw Prediction feature.
- Play back the data set to compare the outcome to the hypothesis.
- Analyze data using functions such as interpolation, tangential rate, or modeling.
- Send collected data to other TI-Nspire™ applications.
- Access sensor data from all connected sensor probes through your TI-Basic program.

Adding a Vernier DataQuest™ Page

Note: The application is launched automatically when you connect a sensor.

Starting a new document or problem for each new experiment ensures that the Vernier DataQuest™ application is set to its default values.

▶ To start a new document containing a data collection page:

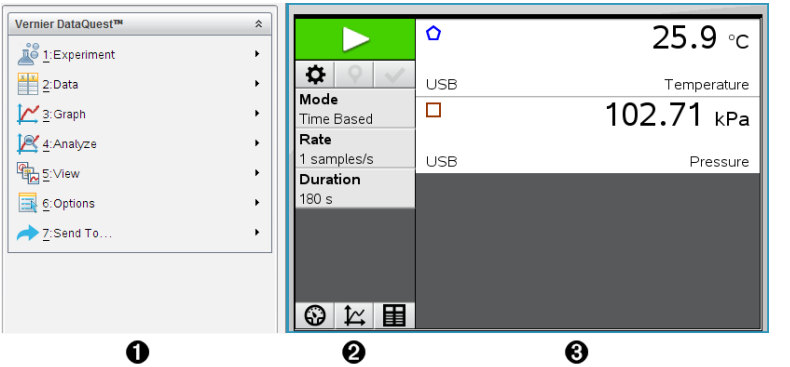
From the main **File** menu, click **New Document**, and then click **Add Vernier DataQuest™**.

Handheld: Press [⌂ on], and select **Vernier DataQuest™**  .

▶ To insert a new problem with a data collection page into an existing document:

From the toolbar, click **Insert > Problem > Vernier DataQuest™**.

Handheld: Press [doc ▾] and select **Insert > Problem > Vernier DataQuest™**.



❶ **Vernier DataQuest™ Menu.** Contains menu items for setup, collection, and analysis of sensor data.

❷ **Details view.** Contains buttons for starting data collection, changing collection settings, marking collected data, storing data sets, and tabs for managing multiple data runs.

View selection buttons let you choose from Meter view, Graph view, or Table view.

❸ **Data work area.** The information displayed here depends on the view.

Meter. Displays a list of sensors that are currently connected or set up in advance.

Graph. Displays collected data in a graphical representation, or displays the prediction before a data collection run.

Table. Displays collected data in columns and rows.

What You Must Know

Basic Steps in Performing an Experiment

These basic steps are the same no matter which type of experiment you perform.

1. Start the Vernier DataQuest™ Application.
2. Connect sensors.
3. Modify sensor settings.
4. Select the collection mode and collection parameters.
5. Collect data.
6. Stop collecting data.
7. Store the data set.
8. Save the document to save all data sets in the experiment.
9. Analyze the data.

Sending Collected Data to Other TI-Nspire™ Applications

You can send collected data to the Graphs, Lists & Spreadsheet, and Data & Statistics applications.

▶ From the **Send To** menu, click the name of the application.

A new page showing the data is added to the current problem.

About Vernier Go Direct® Sensors

The Vernier DataQuest™ application now supports Vernier Go Direct® sensors for your experiments. This can be done via direct connect over USB or over Bluetooth using the TI Bluetooth® Adapter (with Sketch v1.1.1 and later).

You can connect up to four Go Direct sensors over Bluetooth and up to four channels for multi-channel sensors.

Note: This functionality is available on the handheld only at this time, but tns documents saved on the handheld will work in the desktop software.

Supported Sensors

- Go Direct® 3-Axis Magnetic Field Sensor (GDX-3MG)
- Go Direct® Colorimeter (GDX-COL)
- Go Direct® Conductivity Probe (GDX-CON)
- Go Direct® Current Probe (GDX-CUR)
- Go Direct® Force and Acceleration Sensor (GDX-FOR)
- Go Direct® Gas Pressure Sensor (GDX-GP)
- Go Direct® Hand Dynamometer (GDX-HD)
- Go Direct® Light and Color Sensor (GDX-LC)
- Go Direct® Motion Detector (GDX-MD)
- Go Direct® pH Sensor (GDX-PH)
- Go Direct® Temperature Probe (GDX-TMP)
- Go Direct® Voltage Probe (GDX-VOLT)

More sensors will be supported in the future.

Connecting via USB

Connecting a Go Direct sensor via USB automatically launches the Vernier DataQuest™ application with no additional setup.

Note: It is recommended to use the mini-A to micro-B cable from Vernier Science Education to connect the Go Direct sensor to the calculator.

Connecting via Bluetooth

1. Attach the TI Bluetooth® Adapter to the handheld.

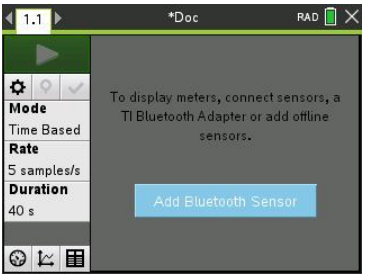
   Make sure the green power light is on and the sensor is fully charged.

2. Press the On/Power button on the sensor.

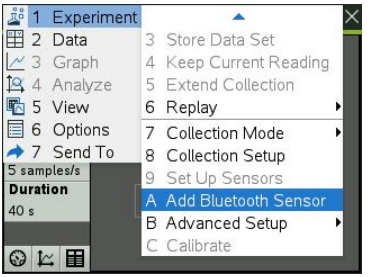
   Make sure the Bluetooth light is blinking red (waiting to connect). If too much time elapses, the light will stop blinking and you will not be able to connect. If so, press the On/Power button again.

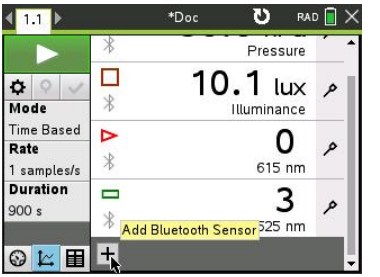
3. Press [on], and select **Vernier DataQuest™** .

4. Click the **Add Bluetooth Sensor** button.

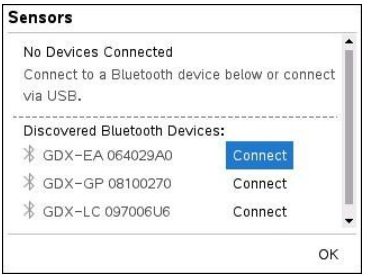


A Bluetooth sensor can also be added through the **Experiments > Add Bluetooth sensor** menu, or by clicking the + icon in the DataQuest™ app main view.





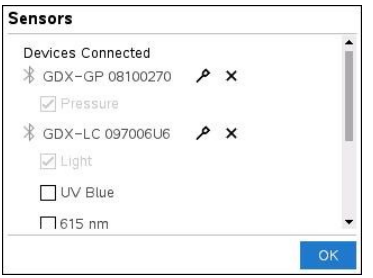
On the **Sensors** dialog under **Discovered Bluetooth Devices**, you should see your device. All Vernier Bluetooth devices will be shown with their Order Code and ID.



If you do not see your sensor, make sure the sensor is powered on and close to the TI Bluetooth® Adapter. Click **OK** to close the dialog and repeat this step.

5. Click **Connect** next to the sensor you want to use.

   Once connected, the **Sensors** dialog will show options specific to that sensor. you can also get device information, add or remove channels (for multi-channel sensors), or disconnect the device.



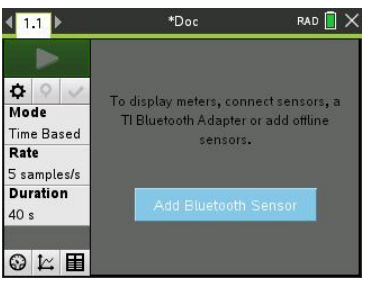
6. Select or deselect the options as needed and click **OK**.

   Repeat steps 4 through 6 to add another sensor for your experiment.

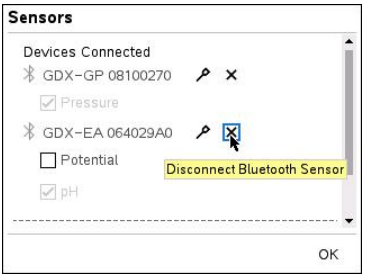
7. Start collecting data with each connected sensor.

Disconnecting a Sensor

1. Click the **Add Bluetooth Sensor** button or use the **Experiments > Add Bluetooth sensor** menu item.



2. Click the icon to the right of the device ID.



About Vernier LabQuest® Sensors

You can select from a variety of Vernier LabQuest® sensors and interfaces to collect data while running the Vernier DataQuest™ application with TI-Nspire™ software.

TI-Nspire™ Lab Cradle

The TI-Nspire™ Lab Cradle lets you connect more than one LabQuest® sensor at a time.

Sensor Interface	Description
 **Texas Instruments TI-Nspire™ Lab Cradle**	This sensor can be used with a handheld, a computer, or as a stand-alone sensor. The sensor interface allows you to connect and use one to five sensors at the same time. It can be used in the lab or at a remote collection location. The Lab Cradle supports two digital sensors and three analog sensors. The Lab Cradle also supports high-sample data collection sensors, such as a hand-grip heart rate or a blood pressure monitor. After using the Lab Cradle as a remote sensor, you can download data to either a handheld or computer.

Single-Channel Sensor Interfaces

Single-channel sensor interfaces can only connect to one sensor at a time. These sensors have either a mini-USB connector for a handheld or a standard USB connector for a computer. For a complete list of compatible sensors, see *Compatible Sensors*.

Sensor Interface	Description
 **Vernier EasyLink®**	This sensor interface is used with handhelds. It has a mini-USB connector so it can be plugged directly into the handheld. Connect sensors to Vernier EasyLink® to: • Measure barometric pressure. • Measure the salinity of a solution. • Investigate the relationship between pressure and volume (Boyles' Law).
 **Vernier Go!Link®**	This sensor interface is used with computers. It has a standard connector so it can be plugged into a Windows® or Mac® computer. Connect sensors to Vernier GoLink® to: • Measure the acidity or alkalinity of a solution. • Monitor greenhouse gases. • Measure sound level in decibels.

Types of LabQuest® Sensors

- **Analog sensors.** Temperature, light, pH, and voltage sensors are analog sensors and require a sensor interface.
- **Digital sensors.** Photogates, radiation monitors, and drop counters are digital sensors. These sensors can only be used with the TI-Nspire™ Lab Cradle.
- **Direct-connect USB sensors.** These sensors connect directly to a handheld or computer and do not require a sensor interface.

Sensors for Handhelds

The following lists some sensors you can use with a handheld.

Sensor	Description
 **Texas Instruments CBR 2™**	This analog sensor connects directly to TI-Nspire™ CX II handhelds through the mini-USB port. It is used to explore and graph motion. This sensor automatically launches the Vernier DataQuest™ application when you connect it to a handheld. Data collection begins when you select the Motion Match function. This sensor collects up to 200 samples per second. Use this sensor to: • Measure position and speed of a person or object. • Measure the acceleration of an object.

Sensor	Description
 **Vernier EasyTemp® temperature sensor**	This analog sensor connects directly to TI-Nspire™ CX II handhelds through the mini-USB port and is used to collect temperature ranges. You can design experiments to: • Collect weather data. • Record temperature changes due to chemical reactions. • Perform heat fusion studies.

Sensors for Computers

The following table lists some sensors you can use with a computer.

Sensor	Description
 **Vernier Go!Temp® temperature sensor**	This analog sensor connects to the computer's USB port and is used to collect temperature ranges. You can use this sensor to: • Collect weather data. • Record temperature changes due to chemical reactions. • Perform heat fusion studies.
 **Vernier Go!Motion® motion detector**	This analog sensor connects to the computer's USB port and is used to measure acceleration, speed, and velocity. Use this sensor to: • Measure position and speed of a person or object. • Measure the acceleration of an object.

Compatible LabQuest® Sensors

The following sensors can be used with the Vernier DataQuest™ application.

- 25-g Accelerometer
- 30-Volt Voltage Probe
- 3-Axis Accelerometer
- Low-g Accelerometer

- CBR 2™ - Connects directly to handheld USB port
- Go!Motion® - Connects directly to computer USB port
- Extra Long Temperature Probe
- Stainless Steel Temperature Probe
- Surface Temperature Sensor
- Ammonium Ion-Selective Electrode
- Anemometer
- Barometer
- Blood Pressure Sensor
- C02 Gas Sensor
- Calcium Ion-Selective Electrode
- Charge Sensor
- Chloride Ion-Selective Electrode
- Colorimeter
- Conductivity Probe
- High Current Sensor
- Current Probe
- Differential Voltage Probe
- Digital Radiation Monitor
- Dissolved Oxygen Sensor
- Dual-Range Force Sensor
- EasyTemp® - Connects directly to handheld USB port
- EKG Sensor
- Electrode Amplifier
- Flow Rate Sensor
- Force Plate
- Gas Pressure Sensor
- Go!Temp® - Connects directly to computer USB port
- Hand Dynamometer
- Hand-Grip Heart Rate Monitor
- Instrumentation Amplifier
- Light Sensor
- Magnetic Field Sensor
- Melt Station
- Microphone

- Nitrate Ion-Selective Electrode
- O2 Gas Sensor
- ORP Sensor
- pH Sensor
- Relative Humidity Sensor
- Respiration Monitor Belt (Requires Gas Pressure Sensor)
- Rotary Motion Sensor
- Salinity Sensor
- Soil Moisture Sensor
- Sound Level Meter
- Spirometer
- Thermocouple
- TI-Light - Sold only with the CBL 2™
- TI-Temp - Sold only with the CBL 2™
- TI-Voltage - Sold only with the CBL 2™
- Tris-Compatible Flat pH Sensor
- Turbidity Sensor
- UVA Sensor
- UVB Sensor
- Vernier Constant Current System
- Vernier Drop Counter
- Vernier Infrared Thermometer
- Vernier Motion Detector
- Vernier Photogate
- Voltage Probe
- Wide-Range Temperature Probe

Connecting LabQuest® Sensors

Direct-connect USB sensors, such as the Vernier Go!Temp® temperature sensor (for computers) or the Vernier EasyLink® temperature sensor (for handhelds), connect directly to the computer or handheld and do not need a sensor interface.

Other sensors require a sensor interface such as the TI-Nspire™ Lab Cradle.

Connecting Directly

▶ Attach the cable on the sensor directly to the computer's USB port or to an appropriate port on the handheld.

Connecting through a Sensor Interface

1. Attach the sensor to the sensor interface using either the mini-USB, USB, or BT connector and the appropriate cable.
2. Attach the interface to a computer or handheld using the appropriate connector and cable.

   Note: To attach a handheld to a TI-Nspire™ Lab Cradle, slide the handheld into the connector at the bottom of the Lab Cradle.

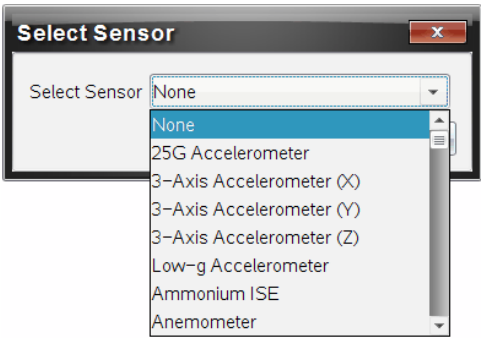
Setting Up an Offline Sensor

You can predefine meter settings for a sensor that is not currently attached to a computer or handheld.

You cannot use the sensor offline, but you can prepare the experiment for it and then attach it when ready to collect the data. This option makes it faster to share a sensor during a lesson or lab in which there are not enough sensors for everyone.

1. From the **Experiment** menu, select **Advanced Set Up > Configure Sensor > Add Offline Sensor**.

   The Select Sensor dialog box opens.



2. Select a sensor from the list.
3. Click the **Meter View** tab .
4. Click the sensor you have added, and modify its settings.

   The settings will be applied when you attach the sensor.

Removing an offline sensor

1. From the **Experiment** menu, select **Advanced Setup > Configure Sensor**.
2. Select the name of the offline sensor to remove.
3. Click **Remove**.

Modifying Sensor Settings

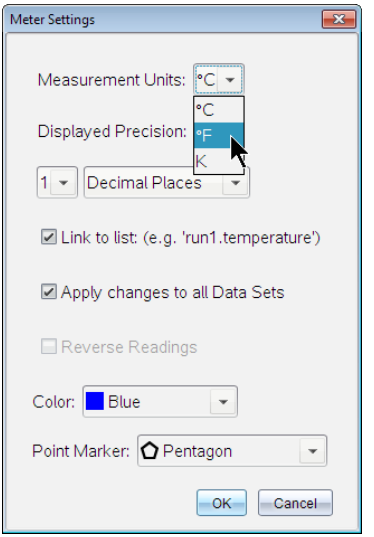
You can modify how the sensor values are displayed and stored. For example, when using a temperature sensor, you can change the unit of measure from Centigrade to Fahrenheit.

Changing Sensor Measurement Units

Measurement units depend on the selected sensor. For example, units for the Vernier Go!Temp® Temperature sensor are Fahrenheit, Celsius, and Kelvin. Units for the Vernier Hand Dynamometer (a specialized force sensor) are Newton, Pound, and Kilogram.

You can change the units before or after you collect data. The collected data reflects the new measurement unit.

1. Click Meter view to display the connected and offline sensors.
2. Click the sensor whose units you want to change.
3. In the Meter Settings dialog box, select the unit type from the **Measurement Units** menu.



Calibrating a Sensor

When the software or handheld detects a sensor, the calibration for that sensor automatically loads. You can calibrate some sensors manually. Other sensors, such as the Colorimeter and the Dissolved Oxygen Sensor, must be calibrated to provide useful data.

There are three options for calibrating a sensor:

- Manual Entry
- Two Point
- Single Point

Refer to the sensor's documentation for specific calibration values and procedures.

Note: Calibration for Vernier Go Direct® sensors is not supported at this time.

Setting a Sensor to Zero

You can set the standing value of some sensors to zero. You cannot set sensors in which relative measurements such as force, motion, and pressure are common to zero. Sensors designed to measure specific environmental conditions, such as Temperature, pH, and CO_2 also cannot be set to zero.

1. Click Meter view to display the connected and offline sensors.
2. Click the sensor that you want to set to zero.
3. In the Meter Settings dialog box, click **Zero**.

Reversing a Sensor's Readings

By default, pulling with a force sensor produces a positive force and pushing produces a negative force. Reversing the sensor allows you to display pushing as a positive force.

1. Click Meter view to display the connected and offline sensors.
2. Click the sensor that you want to reverse.
3. In the Meter Settings dialog box, click **Reverse Readings**.

   The sensor display is now reversed. In Meter View, the reverse indicator appears after the sensor name.

Collecting Data

Collecting Time-Based Data

The Time Based collection mode captures sensor data automatically at regular time intervals.

1. Connect the sensor or sensors.

   Sensor names are added to the sensor list automatically.

2. From the **Experiment** menu, select **New Experiment**.

   This removes all data and restores all meter settings to their defaults.

3. From the **Experiment** menu, select **Collection Mode > Time Based**.

   a) Select **Rate** or **Interval** from the drop-down list, and then type the **Rate** (samples/second) or **Interval** (seconds/sample).

   b) Type the **Duration** of the collection.

      The Number of points is calculated and displayed, based on rate and duration. Note that collecting too many data points can slow system performance.

   c) Select **Strip Chart** if you want to collect samples continuously, retaining only the last n samples. (where "n" is the number shown in the Number of points field.)

4. Modify sensor settings as necessary.
5. Click **Start Collection** .
6. After the data has been collected, click **Stop Collection** .

   The data set run is complete.

Collecting Selected Events

Use the Selected Events collection mode to capture samples manually. In this mode, each sample is automatically assigned an event number.

1. Connect the sensor or sensors.

Sensor names are added to the sensor list automatically.

2. From the **Experiment** menu, select **New Experiment**.

   This removes all data and restores all meter settings to their defaults.

3. From the **Experiment** menu, select **Collection Mode > Selected Events**.

   The Selected Events Setup dialog box opens.

   - **Name**. This text is visible in the Meter View. Its first letter is displayed as the independent variable in the Graph view.
   - **Units**. This text is displayed in Graph view alongside the Name.
   - **Average over 10 s.** This option averages ten seconds of data for each point.

4. Modify sensor settings as necessary.
5. Click **Start Collection**  .

   The Keep Current Reading icon  becomes active. The current sensor value appears in the center of the graph.

6. Click **Keep Current Reading**  to capture each sample.

   The data point is plotted, and the current sensor value appears in the center of the graph.

   Note: If you selected the Averaging option, a countdown timer appears. When the counter reaches zero, the system plots the average.

7. Continue capturing until you collect all of the desired data points.
8. Click **Stop Collection**  .

   The data set run is complete.

Collecting Events with Entry

Use the Events with Entry collection mode to capture samples manually. In this mode, you define the independent value for each point you collect.

1. Connect the sensor or sensors.

   Sensor names are added to the sensor list automatically.

2. From the **Experiment** menu, select **New Experiment**.

   This removes all data and restores all meter settings to their defaults.

3. From the **Experiment** menu, select **Collection Mode > Events with Entry**.

   The Events with Entry Setup dialog box opens.

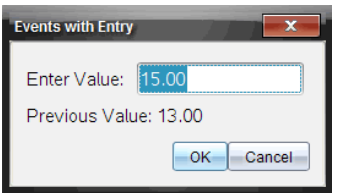
   - **Name.** This text is visible in the Meter View. Its first letter is displayed as the independent variable in the Graph view.
   - **Units.** This text is displayed in Graph view alongside the Name.
   - **Average over 10 s.** This option averages ten seconds of data for each point.

4. Modify sensor settings as necessary.
5. Click **Start Collection** .

   The Keep Current Reading icon becomes active. The current sensor value appears in the center of the graph.

6. Click **Keep Current Reading** to capture a sample.

   The Events with Entry dialog box opens.



7. Type a value for the independent variable.
8. Click **OK**.

   The data point is plotted, and the current sensor value appears in the center of the graph.

   Note: If you selected the Averaging option, a countdown timer appears. When the counter reaches zero, the system plots the average.

9. Repeat steps 6 through 8 until you collect all of the desired data points.
10. Click **Stop Collection** .

    The data set run is complete.

Collecting Photogate Timing Data

The Photogate Timing collection mode is available only when using the Vernier Photogate sensor. This sensor can time objects that pass through the gates or objects that pass outside of the gates.

1. Connect the Photogate sensor or sensors.

   Sensor names are added to the sensor list automatically.

2. From the **Experiment** menu, select **New Experiment**.

   This removes all data and restores all meter settings to their defaults.

3. From the **Experiment** menu, select **Collection Mode > Photogate Timing**.
4. Set the collection options.
5. Modify sensor settings as necessary.
6. Click **Start Collection**  .
7. After the data has been collected, click **Stop Collection**  .

   The data set run is complete.

Collecting Drop Counter Data

The Drop Counting collection mode is available only when using the Vernier Drop Counter optical sensor. This sensor can count the number of drops or record the amount of liquid added during an experiment.

1. Connect the Drop Counter sensor or sensors.

   Sensor names are added to the sensor list automatically.

2. From the **Experiment** menu, select **New Experiment**.

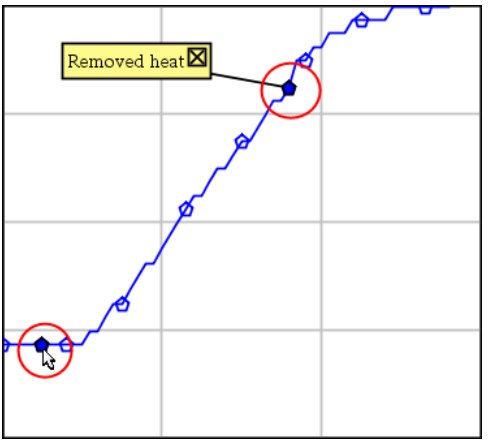
   This removes all data and restores all meter settings to their defaults.

3. From the **Experiment** menu, select **Collection Mode > Drop Counting**.
4. Set the collection options.
5. Modify sensor settings as necessary.
6. Click **Start Collection**  .
7. After the data has been collected, click **Stop Collection**  .

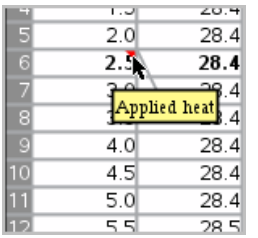
   The data set run is complete.

Using Data Markers to Annotate Data

Data markers give you a way to emphasize specific data points, such as when you change a condition. For example, you might mark a point at which a chemical is added to a solution or when heat is applied or removed. You can add a marker with or without a comment, and you can hide a comment.



Two data markers, one with a comment displayed



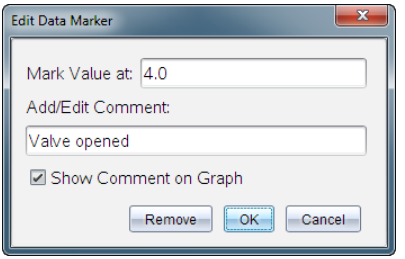
Marker shown as red triangle in Table view

Adding a Marker During Data Collection

▶ Click **Add Data Marker** to place a marker at the current data point.

Adding a Marker After Collecting Data

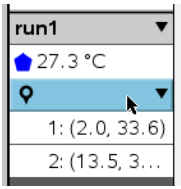
1. In Graph or Table view, click the point at which you want a marker.
2. Click **Add Data Marker** .



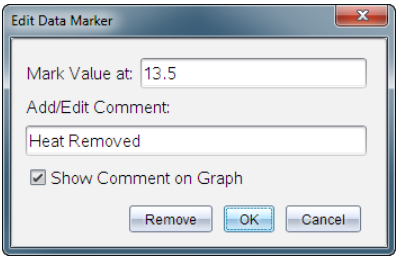
3. Complete the items in the dialog box.

Adding a Comment to an Existing Marker

1. In the Detail view, click to expand the list of markers for the data set.

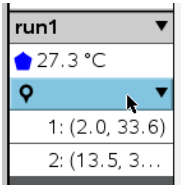


2. Click the entry for the marker that you want to change, and complete the items in the dialog box.



Repositioning a Data Marker

1. Click to expand the list of markers in the Detail view.



2. Click the entry for the marker that you want to change.
3. In the dialog box, type a new value for **Mark Value at**.

Moving a Data Marker's Comment in the Graph View

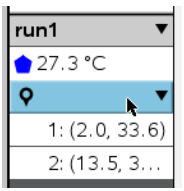
▶ Drag the comment to move it. The connecting line remains attached to the data point.

Hiding/Showing a Data Marker's Comment

▶ Hide a comment by clicking the **X** at the end of the comment.

▶ To restore a hidden comment:

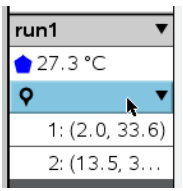
a) Click to expand the list of markers in the Detail view.



b) Click the entry for the marker that you want to change, and check **Show Comment on Graph**.

Removing a Data Marker

1. Click to expand the list of markers in the Detail view.



2. In the dialog box, click **Remove**.

Collecting Data Using a Remote Collection Unit

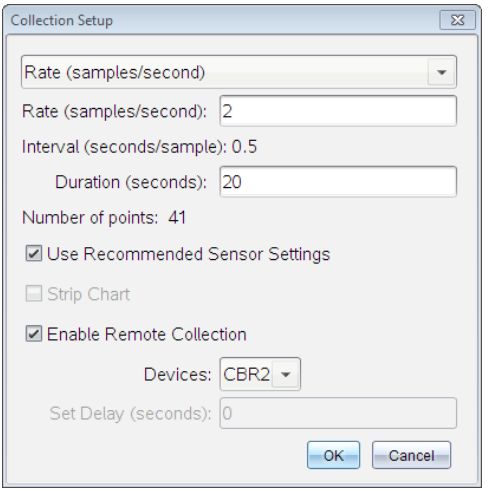
To collect information from a sensor while it is disconnected, you can set it up as a remote sensor. Only the TI-Nspire™ Lab Cradle, TI CBR 2™, and Vernier Go!Motion® support remote data collection.

You can set up a remote collection unit to start collecting:

- When you press a manual trigger on the unit, as on the TI-Nspire™ Lab Cradle
- When a delay countdown expires on a unit that supports a delayed start

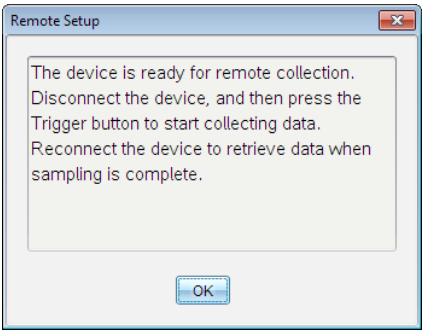
Setting Up for Remote Collection

1. Save and close any open documents, and start with a new document.
2. Connect the remote collection unit to the computer or handheld.
3. Modify the sensor settings.
4. Click the Collection Setup button .
5. On the Collection Setup screen, check **Enable Remote Collection**.
6. Select the remote collection unit from the **Devices** list.
7. Specify the method for starting the collection:
   - To start automatically after a specified delay (on supported units), type the delay value.
   - To start when you press the manual trigger (on supported units), type a delay value of **0**. When you use a delay, the manual trigger button on the TI-Nspire™ Lab Cradle has no effect on the start of the collection.



8. Click **OK**.

   A message confirms that the unit is ready.



9. Disconnect the unit.

   Depending on the device, LED lights may indicate its status.

   Red. The system is not ready.

   Amber. The system is ready but not collecting data.

   Green. The system is collecting data.

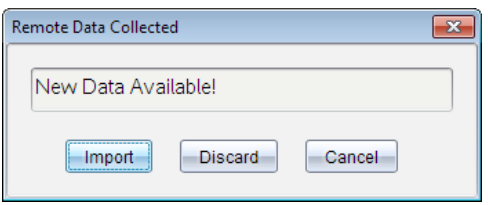
10. If you are starting collection manually, press the trigger when ready. If you are starting based on a delay, the collection will start automatically when the countdown is complete.

Retrieving the Remote Data

After collecting data remotely, you transfer it to the computer or handheld for analysis.

1. Open the Vernier DataQuest™ application.
2. Attach the TI-Nspire™ Lab Cradle to the handheld or computer.

   The Remote Data Detected dialog box opens.



3. Click **Import**.

   The data transfers to the Vernier DataQuest™ application.

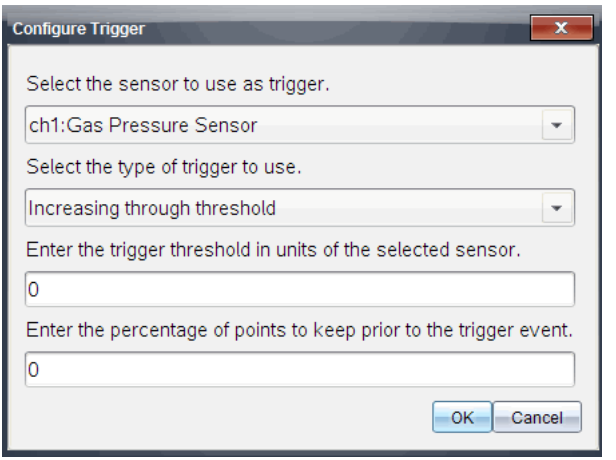
Setting Up a Sensor for Automatic Triggering

To start data collection automatically based on a specific sensor reading, the TI-Nspire™ Lab Cradle and sensor must be connected.

1. Connect the sensor.

2. Click **Experiment > Advanced Set up > Triggering > Set Up**.

   The Configure Trigger dialog box opens.



3. Select the sensor from the **Select the sensor to use as trigger** drop-down list.

   Note: The menu displays the sensors connected to the TI-Nspire™ Lab Cradle.

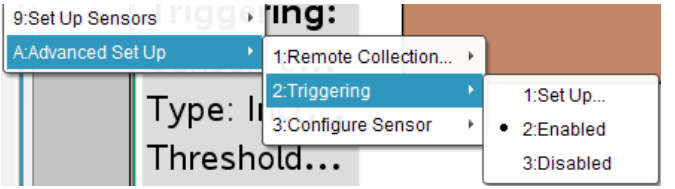
4. Select one of the following from the **Select the type of trigger to use** drop-down list.
   - **Increasing through threshold.** Use to trigger on increasing values.
   - **Decreasing through threshold.** Use to trigger on decreasing values.
5. Type the appropriate value in the **Enter the trigger threshold in units of the selected sensor** field.

   When entering the trigger value, enter a value within the range of the sensor.

   If you change the unit type after setting the threshold, the value automatically updates.

   For example, if you use the Vernier Gas Pressure sensor with the units set as atm and you later change the units to kPa, the settings are updated.
6. Type the number of data points to keep before the trigger value occurs.
7. Click **OK**.

   The trigger is now set and enabled if values were entered.
8. (Optional) Select **Experiment > Advanced Set up > Triggering** to verify the active indicator is set to Enabled.



Important: When the trigger is enabled, it stays active until it is disabled or you start a new experiment.

Enabling a Disabled Trigger

If you set the trigger values in the current experiment, and then disable them, you can enable the triggers again.

To enable a trigger:

▶ Click **Experiment > Advanced Set Up > Triggering > Enable**.

Disabling an Enabled Trigger

To disable the active trigger.

▶ Click **Experiment > Advanced Set Up > Triggering > Disable**.

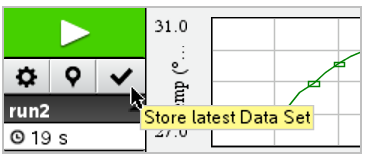
Collecting and Managing Data Sets

By default, the **Start Collection** button overwrites collected data with data from the next run. To preserve each run, you can store it as a data set. After collecting multiple data sets, you can superimpose any combination of them on the Graph View.

Important: Stored data sets are lost if you close the document without saving it. If you want stored data to be available later, make sure to save the document.

Storing Data as Sets

1. Collect the data from the first run. (See Collecting Data.)
2. Click the **Store Data Set** button .

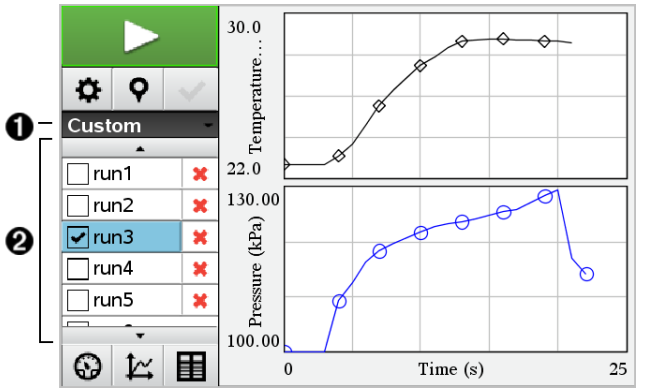


The data is stored as **run1**. A new data set, **run2**, is created for collecting the next run.

3. Click **Start Collection** to collect data for **run2**.

Comparing Data Sets

1. Click the **Graph View** icon to show the graph.
2. Click the Data Set Selector (near the top of the Detail View) to expand the list of data sets.

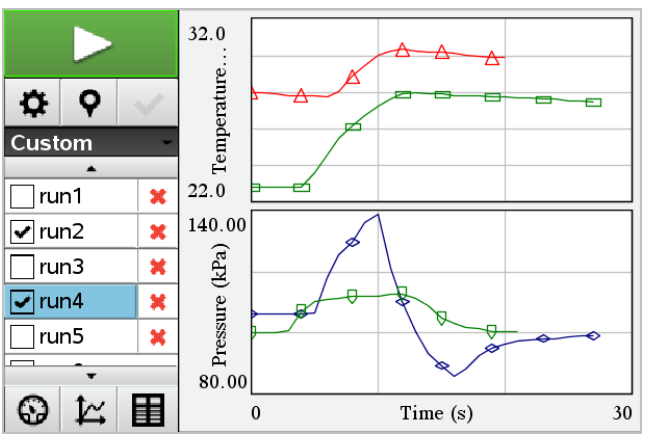


❶ Data Set Selector lets you expand or collapse the list.

❷ Expanded list shows available data sets. Scroll buttons appear as necessary to let you scroll the list.

3. Choose which data sets to view by selecting or clearing the check boxes.

   The graph is rescaled as necessary to show all selected data.

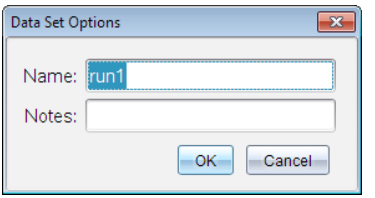


Tip: To quickly select a single data set, hold down **Shift** while clicking its name in the list. The graph shows only the selected set, and the list is collapsed automatically to help you view details of the data.

Renaming a Data Set

By default, data sets are named **run1**, **run2**, and so on. The name of each data set is displayed in the Table view.

1. Click the **Table View** icon to show the table.
2. Display the context menu for the table view, and select **Data Set Options >** [*current name*].



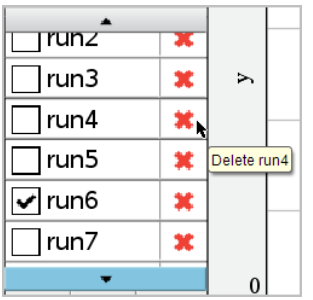
3. Type the new **Name**.

   Note: The maximum character limit is 30. The name cannot contain commas.

4. (Optional) Type **Notes** about the data.

Deleting a Data Set

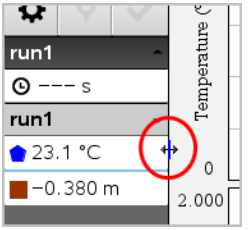
1. Click the **Graph View** icon to show the graph.
2. Click the Data Set Selector (near the top of the Detail View) to expand the list of data sets.
3. Scroll the list as necessary, and then click the Delete symbol (**X**) next to the name of the data set.



4. Click **OK** on the confirmation message.

Expanding the View Details Area

▶ Drag the boundary at the right edge of the Details area to increase or decrease its width.



Using Sensor Data in Python Programs

You can collect and graph data in Python programs from Vernier Go Direct® sensors through the TI Bluetooth® Adapter (with Sketch v1.1.1 or later).

Note: This functionality is not available for sensors connected directly over USB.

Setting up Python to use Go Direct data

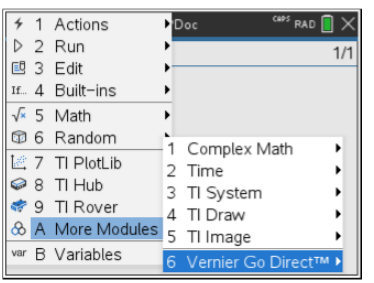
1. Download and install the Python module for the Go Direct sensors from the resource page on the Texas Instruments Education website.

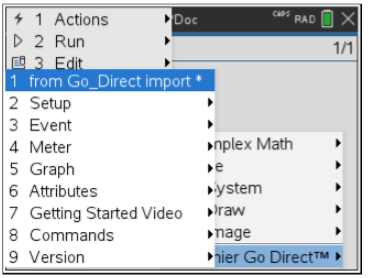
   The module supports three ways to collect the sensor data:

   - Meter mode – Numeric display of the data.
   - Graph mode – Graphical display of the data (that can be customized if needed).
   - Events with entry – Collect the data based on specific user actions.

   Each option can be used independently.

   After the module is installed, you will see a new item on the **More Modules** menu in the Python editor with the available functionality.





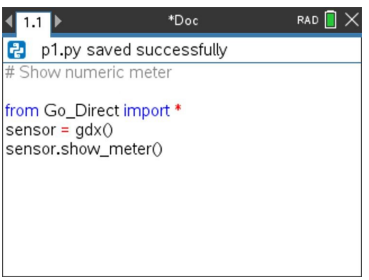
2. Pair a Go Direct sensor with the TI Bluetooth® Adapter.

   Turn the sensor on and use the **`configure()`** function to find and pair the sensor with the adapter. Use the ID that is printed on the sensor when prompted to enter the sensor ID.

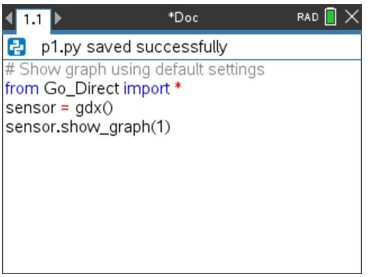
   When the pairing process completes, the TI Bluetooth® Adapter will store the ID of the connected sensor and that configuration is available for use without re-configuration. This allows the same sensor-adapter pair to be re-used multiple times in different experiments.

3. Collect and display data from the Python program using one of the following data collection methods.

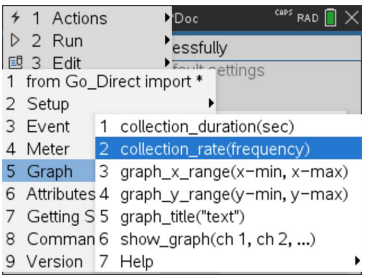
   Meter View



   Graph View



The graph settings are set to defaults that display the sensor name and the default range. You can change the title, range, and sample rate using the functions in the module.



The collected data is also stored in lists for additional analysis using the Lists and Spreadsheets application.

Using Sensor Data in TI-Basic Programs

You can access sensor data from all connected sensor probes – Vernier LabQuest™ and Vernier Go Direct® (USB and Bluetooth®) – through your TI-Basic program by using this command:

RefreshProbeVars statusVar

- You must first launch the Vernier DataQuest™ application, or you will receive an error. 

  Note: The Vernier DataQuest™ application will auto-launch when you connect a sensor or a lab cradle to the TI-Nspire™ software or handheld.

- The *RefreshProbeVars* command will be valid only when Vernier DataQuest™ is in 'meter' mode. 
- *statusVar* is an optional parameter that indicates the status of the command. These are the *statusVar* values:

StatusVar Value	Status
statusVar=0	Normal (continue with the program)
statusVar=1	The Vernier DataQuest™ application is in data collection mode. **Note:** The Vernier DataQuest™ application must be in meter mode for this command to work. 
statusVar=2	The Vernier DataQuest™ application is not launched.
statusVar=3	The Vernier DataQuest™ application is launched, but you have not connected any probes.

- Your TI-Basic program will read directly from Vernier DataQuest™ variables in the symbol table.
- The meter.time variable shows the last value of the variable; it does not update automatically. If no data collection has occurred, meter.time will be 0 (zero).
- Use of variable names without corresponding probes being physically attached will result in a "Variable not defined" error.

Collecting Sensor Data using RefreshProbeVars

1. Launch the Vernier DataQuest™ application.
2. Connect the sensor(s) you need to collect the data.
3. Run the program you wish to use to collect data in the calculator application.
4. Manipulate the sensors and collect the data.

Note: You may create a program to interact with the TI-Innovator™ Hub using menu **> Hub > Send**. (See Example 2, below.) This is optional.

Example 1

```
Define temp()=
Prgm
© Check if system is ready
RefreshProbeVars status
If status=0 Then
Disp "ready"
For n,1,50
RefreshProbeVars status
temperature:=meter.temperature
Disp "Temperature: ",temperature
If temperature>30 Then
Disp "Too hot"
EndIf
© Wait for 1 second between samples
```

```
Wait 1
EndFor
Else
Disp "Not ready. Try again later"
EndIf
EndPrgm
```

Example 2 - with TI-Innovator™ Hub

```
Define tempwithhub()=
Prgm
© Check if system is ready
RefreshProbeVars status
If status=0 Then
Disp "ready"
For n,1,50
RefreshProbeVars status
temperature:=meter.temperature
Disp "Temperature: ",temperature
If temperature>30 Then
Disp "Too hot"
© Play a tone on the Hub
Send "SET SOUND 440 TIME 2"
EndIf
© Wait for 1 second between samples
Wait 1
EndFor
Else
Disp "Not ready. Try again later"
EndIf
EndPrgm
```

Analyzing Collected Data

In the Vernier DataQuest™ application, use Graph View to analyze data. Start by setting up graphs, and then use analysis tools such as integral, statistics, and curve fit to investigate the mathematical nature of the data.

Important: The Graph menu and Analyze menu items are only available when working in Graph View.

Finding the Area Under a Data Plot

Use Integral to determine the area under a data plot. You can find the area under all of the data or a selected region of the data.

To find the area under a data plot:

1. Leave the graph unselected to examine all the data, or select a range to examine a specific area.
2. Click **Analyze > Integral**.
3. Select the plotted column name if you have more than a single column.

The data plot area is displayed in the View Details area.

Finding the Slope

Tangent displays a measure of the rate at which the data is changing at the point you are examining. The value is labeled “Slope.”

To find the slope:

1. Click **Analyze > Tangent**.

   A check mark appears in the menu next to the option.

2. Click the graph.

   The examine indicator is drawn to the nearest data point.

   The values of the plotted data are shown in the View details area and the All Details for Graph dialog box.

   You can move the examine line by dragging, clicking another point, or using the arrow keys.

Interpolating the Value Between Two Data Points

Use Interpolate to estimate the value between two data points and to determine the value of a Curve Fit between and beyond these data points.

The examine line moves from data point to data point. When Interpolate is on, the examine line moves between and beyond data points.

To use Interpolate:

1. Click **Analyze > Interpolate**.

   A check mark appears in the menu next to the option.

2. Click the graph.

   The examine indicator is drawn to the nearest data point.

   The values of the plotted data are shown in the View Details area.

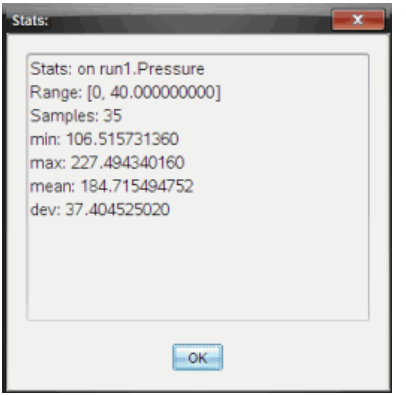
   You can shift the examine line by moving the cursor with the arrow keys or by clicking on another data point.

Generating Statistics

You can generate statistics (minimum, maximum, mean, standard deviation, and number of samples) for all the collected data or for a selected region. You can also generate a curve fit based on one of several standard models or on a model that you define.

1. Leave the graph unselected to examine all the data, or select a range to examine a specific area.
2. Click **Analyze > Statistics**.
3. Select the plotted column name if you have more than a single column. For example, run1.Pressure.

   The Stats dialog box opens.



4. Review the data.
5. Click **OK**.

For information on clearing the Statistics analysis, see *Removing Analysis Options*.

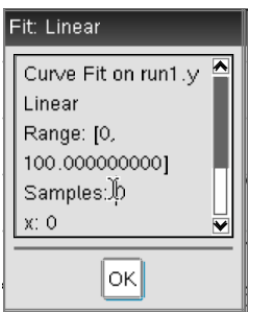
Generating a Curve Fit

Use Curve Fit to find the best curve fit to match the data. Select all of the data or a selected region of data. The curve is drawn on the graph.

1. Leave the graph unselected to examine all the data, or select a range to examine a specific area.
2. Click **Analyze > Curve Fit**.
3. Select a curve fit option.

Curve Fit option	Calculated in the form:
Linear	y = m*x + b
Quadratic	y = a*x^2 + b*x + c
Cubic	y = a*x^3 + b*x^2 + c*x + d
Quartic	y = a*x^4 + b*x^3 + c*x^2 + d*x + e
Power (ax^b)	y = a*x^b
Exponential (ab^x)	y = a*b^x
Logarithmic	y = a + b*ln(x)
Sinusoidal	y = a*sin(b*x + c) + d
Logistic (d $\neq$ 0)	y = c/(1 + a*e^(-bx)) + d
Natural Exponential	y = a*e^(-c*x)
Proportional	y = a*x

The Fit Linear dialog box opens.



4. Click **OK**.
5. Review the data.

For information on clearing the Curve Fit analysis, see *Removing Analysis Options*.

Plotting a Standard or User-Defined Model

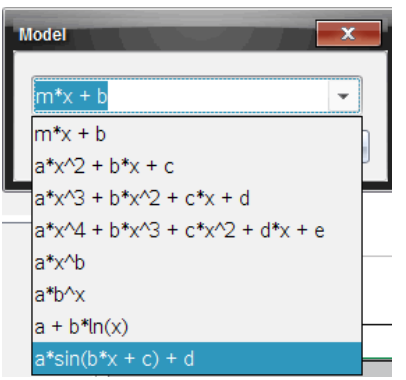
This option provides a manual method for plotting a function to fit data. Use one of the predefined models or enter your own.

You can also set the spin increment to use in the View Details dialog box. Spin increment is the value by which the coefficient changes when you click the spin buttons in the View Details dialog box.

For example, if you set m1=1 as the spin increment, when you click the up spin button the value changes to 1.1, 1.2, 1.3 and so on. If you click the down spin button, the value changes to 0.9, 0.8, 0.7, and so on.

1. Click **Analyze > Model**.

   The Model dialog box opens.



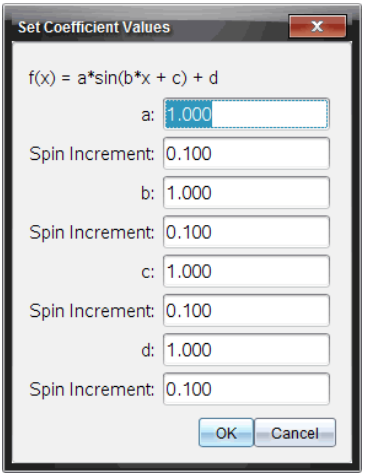
2. Type your own function.

   —or—

   Click to select a value from the drop-down list.

3. Click **OK**.

   The Set Coefficient Values dialog box opens.



4. Type the value for the variables.
5. Type the change in value in the Spin Increment fields.
6. Click **OK**.

   Note: These values are the initial values. You can also adjust these values in the View Details area.

   The model is shown on the graph with adjustment options in the View Details area and in the All Details for Graph dialog box.

7. (Optional) Adjust the window setting for minimum and maximum axis values. For more information, see *Setting the Axis for One Graph*.

For information on clearing the Model analysis, see *Removing Analysis Options*.

8. Click ▲▼ to make any desired adjustments to the coefficients.

   —or—

   Click the value in the View Details area.

This graphic is an example of a model with adjusted values.

Removing Analysis Options

1. Click **Analyze > Remove**.
2. Select the data display you want to remove.

   The display you selected is removed from the graph and the View Details area.

Displaying Collected Data in Graph View

When you collect data, it is written in both the Graph and Table views. Use the Graph view to examine the plotted data.

Important: The Graph menu and Analyze menu items are only active when working in Graph View.

Selecting the Graph View

▶ Click the **Graph View** tab .

Viewing Multiple Graphs

Use the Show Graph menu to show separate graphs when using:

- A sensor that plots more than one column of data.
- Multiple sensors with different defined units at the same time.

In this example, two sensors (the Gas Pressure sensor and the Hand Dynamometer) were used in the same run. The following image shows the columns Time, Force, and Pressure in the Table view to illustrate why two graphs are shown.

Displaying One of Two Graphs

When two graphs are displayed, the top graph is Graph 1 and the bottom graph is Graph 2.

To display only Graph 1:

▶ Select **Graph > Show Graph > Graph 1**.

Only Graph1 is displayed.

To display only Graph 2:

▶ Select **Graph > Show Graph > Graph 2**.

Only Graph 2 is displayed.

Displaying Both Graphs

To display both Graph 1 and Graph 2 together:

▶ Select **Graph > Show Graph > Both**.

Graph1 and Graph 2 are displayed.

Displaying Graphs in the Page Layout View

Use the Page layout view when Show Graph is not the appropriate solution for showing more than one graph.

The Show Graph option is not applicable for:

- Multiple runs using a single sensor.
- Two or more of the same sensors.
- Multiple sensors that use the same column(s) of data.

To use Page Layout:

1. Open the original data set you want to see in two graph windows.
2. Click **Edit > Page Layout > Select Layout**.
3. Select the type of page layout you want to use.
4. Click **Click here to add an application**.
5. Select **Add Vernier DataQuest™**.

   The Vernier DataQuest™ application is added to the second view.
6. To see separate views, click the view you want to change, and then select **View > Table**.

   The new view is displayed.
7. To show the same view, click the view to change.
8. Click **View > Graph**.

   The new view is displayed.

Displaying Collected Data in Table View

Table view provides another way to sort and view collected data.

Selecting the Table View

▶ Click the **Table View** tab  .

Defining Column Options

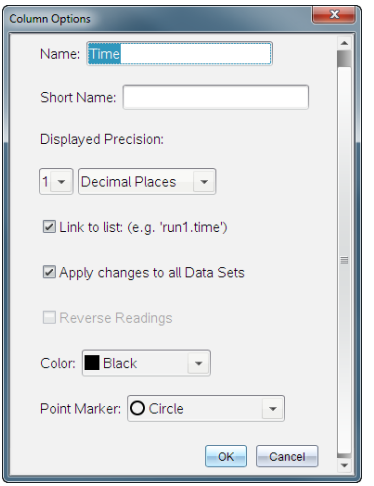
You can name columns and define the decimal points and the precision you want to use.

1. from the **Data** menu, select **Column Options**.

Note: You can be in the Meter, Graph, or Table view and still click these menu options. The results will still be visible.

2. Click the name of the column you want to define.

   The Column Options dialog box opens.



3. Type the long name for the column in the **Name** field.
4. Type the abbreviated name in the **Short Name** field.

   Note: This name is displayed if the column cannot expand to display the full name.

5. Type the number of units in the **Units** field.
6. From the **Displayed Precision** drop-down list, select the precision value.

   Note: The default precision is related to the precision of the sensor.

7. Select **Link to list** to link to the symbol table and make this information available to other TI-Nspire™ applications.

   Note: Linking is the default for most sensors.

   Important: Heart rate and blood pressure sensors require a tremendous amount of data to be useful, and the default for these sensors is to be unlinked to improve system performance.

8. Select **Apply changes to all Data Sets** to apply these settings to all data sets.
9. Click **OK**.

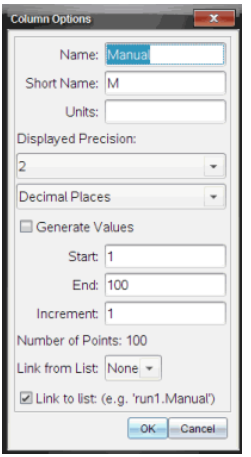
The column settings are now defined with the new values.

Creating a Column of Manually Entered Values

To enter data manually, add a new column. Sensor columns cannot be modified, but data entered manually can be edited.

1. Click **Data > New Manual Column**.

   The Column Options dialog box opens.



2. Type the long name for the column in the **Name** field.
3. Type the abbreviated name in the **Short Name** field.

   Note: This name is displayed if the column cannot expand to display the full name.

4. Type the units to be used.
5. From the **Displayed Precision** drop-down list, select the precision value.

   Note: The default precision is related to the precision of the sensor.

6. (Optional) Select **Apply changes to all Data Sets** to apply these settings to all data sets.
7. (Optional) Select **Generate Values** to automatically populate the rows.

   If you select this option, complete these steps:

   a) Type a starting value in the **Start** field.

   b) Type an ending value in the **End** field.

c) Type the increase in value in the **Increment** field.

The number of points is calculated and shown in the Number of Points field.

8. Select **Link from list** to link to data in another TI-Nspire™ application.

   Note: This list only populates when data exists in the other application and includes a column label.

9. Select **Link to list** to link to the symbol table and make this information available to other TI-Nspire™ applications.

   Note: Linking is the default for most sensors.

   Important: Heart rate and blood pressure sensors require a tremendous amount of data to be useful, and the default for these sensors is to be unlinked to improve system performance.

10. Click **OK**.

    A new column is added to the table. This column can be edited.

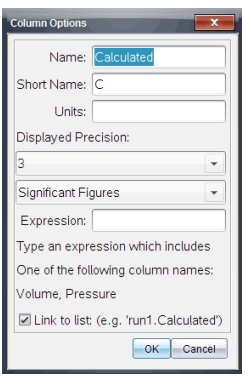
Creating a Column of Calculated Values

You can add an additional column to the data set in which the values are calculated from an expression using at least one of the existing columns.

Use a calculated column when finding the derivative for pH data. For more information, see *Adjusting Derivative Settings*.

1. Click **Data > New Calculated Column**.

   The Column Options dialog box opens.



2. Type the long name for the column in the **Name** field.
3. Type the abbreviated name in the **Short Name** field.

   Note: This name is displayed if the column cannot expand to display the full name.
4. Type the units to be used.
5. From the **Displayed Precision** drop-down list, select the precision value.

   Note: The default precision is related to the precision of the sensor.
6. Type a calculation including one of the column names in the **Expression** field.

   Note: The system-provided column names are dependent on the sensor(s) selected and any changes made to the name field in Column Options.

   Important: The Expression field is case-sensitive. (Example: “Pressure” is not the same as “pressure.”)
7. Select **Link to list** to link to the symbol table and make this information available to other TI-Nspire™ applications.

   Note: Linking is the default for most sensors.

   Important: Heart rate and blood pressure sensors require a tremendous amount of data to be useful, and the default for these sensors is to be unlinked to improve system performance.
8. Click **OK**.

   The new calculated column is created.

Customizing the Graph of Collected Data

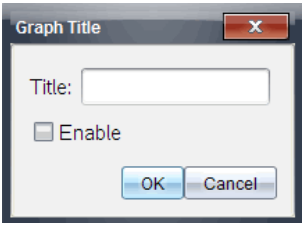
You can customize the Graph view by adding a title, changing colors, and setting ranges for the axis.

Adding a Title

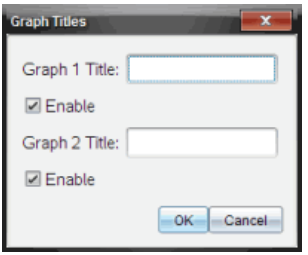
When you add a title to a graph, the title is displayed in the View Details area. When you print the graph, the title prints on the graph.

1. Click **Graph > Graph Title**.

   The Graph Title dialog box opens.



If there are two graphs in the work area, the dialog box has two title options.



2. Type the name of the graph in the Title field.

   —or—

   a) Type the name of the first graph in the Graph 1 field.

   b) Type the name of the second graph in the Graph 2 field.

3. Select **Enable** to show the title.

   Note: Use the Enable option to hide or show the graph title as needed.

4. Click **OK**.

   The title is shown.

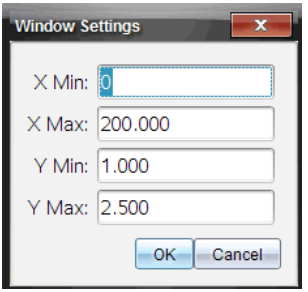
Setting Axis Ranges

Setting Axis Ranges for One Graph

To modify the minimum and maximum range for the x and y axis:

1. Click **Graph > Window Settings**.

   The Window Settings dialog box opens.



2. Type the new values in one or more of these fields:
   - X Min
   - X Max
   - Y Min
   - Y Max
3. Click **OK**.

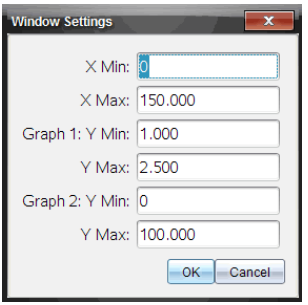
   The application uses the new values for the graph visual range until you modify the range or change data sets.

Setting Axis Ranges for Two Graphs

When working with two graphs, enter two y axis minimum and maximum values, but only one set of minimum and maximum values for the x axis.

1. Click **Graph > Window Setting**.

   The Window Setting dialog box opens.



2. Type the new values in one or more of these fields:
   - X Min

- X Max
- Graph 1: Y Min
- Y Max
- Graph 2: Y Min
- Y Max

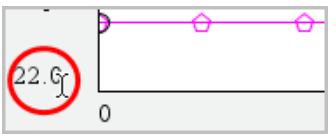
3. Click **OK**.

   The application uses the new values for the graph visual range until you modify the range or change data sets.

Setting the Axis Range on the Graph Screen

You can modify the minimum and maximum range for the x and y axes directly on the graph screen.

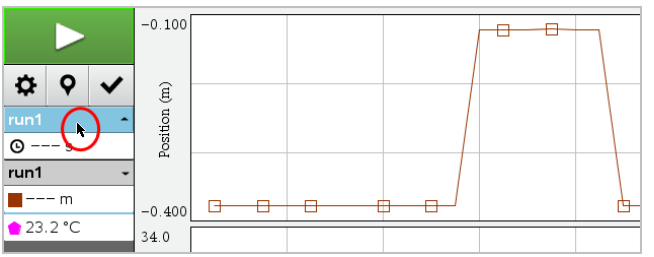
▶ Select the axis value that you want to change, and type a new value.



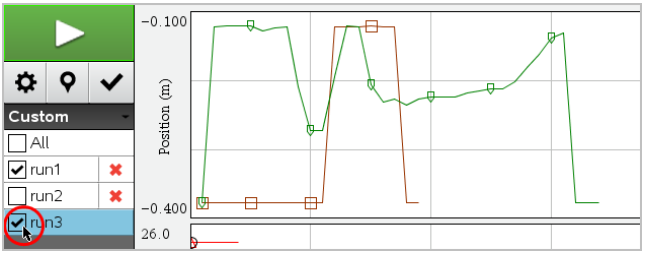
The graph is redrawn to reflect the change.

Selecting which Data Sets to Plot

1. In the Detail view on the left, click the tab immediately below the view selection buttons.



2. The Detail view shows a list of available data sets.
3. Use the check boxes to select the data sets to plot.



Autoscaling a Graph

Use the autoscale option to show all the points plotted. Autoscale Now is useful after you change the x and y axis range or zoom in or out of a graph. You can also define the automatic autoscale setting to use during and after a collection.

Autoscale Now Using the Application Menu

▶ Click **Graph > Autoscale Now**.

The graph now displays all the points plotted.

Autoscale Now Using the Context Menu

1. Open the context menu in the graph area.
2. Click **Window/Zoom > Autoscale Now**.

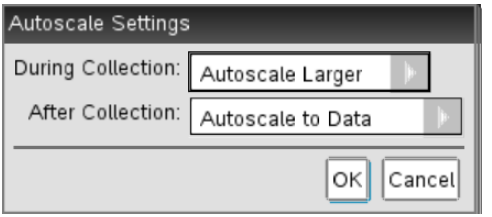
   The graph now displays all the points plotted.

Defining Autoscale During a Collection

There are two options for using the automatic autoscaling that occurs during a collection. To choose an option:

1. Click **Options > Autoscale Settings**.

   The Autoscale Settings dialog box opens.



2. Click ► to open the During Collection drop-down list.
3. Select one of these options:
   - **Autoscale Larger** - Expands the graph as needed to show all points as you collect them.
   - **Do Not Autoscale** - The graph is not changed during a collection.
4. Click **OK** to save the setting.

Defining Autoscale After a Collection

You have three options for setting the automatic autoscaling that occurs after a collection. To set your choice:

1. Click **Options > Autoscale Settings**.

   The Autoscale Settings dialog box opens.
2. Click ► to open the **After Collection** drop-down list.
3. Select one of these options:
   - **Autoscale to Data.** Expands the graph to show all data points. This option is the default mode.
   - **Autoscale From Zero.** Modifies the graph so all data points including the origin point are displayed.
   - **Do Not Autoscale.** The graph settings are not changed.
4. Click **OK** to save the setting.

Selecting a Range of Data

Selecting a range of data on the graph is useful in several situations, such as when zooming in or out, striking and unstriking data, and examining settings.

To select a range:

1. Drag across the graph.

   The selected area is indicated by gray shading.

2. Perform one of these actions.
   - Zoom in or out
   - Strike or unstrike data
   - Examine settings

To deselect a range:

▶ Press the **Esc** key as necessary to remove the shading and the vertical trace line.

Zooming In on a Graph

You can zoom in on a subset of the collected points. You can also zoom out from a previous zoom or expand the graph window beyond the data points collected.

To zoom in on a graph:

1. Select the area you want to zoom into, or use the current view.
2. Click **Graph > Zoom In**.

   The graph adjusts to display only the area you selected.

   The x range selected is used as the new x range. The y range autoscales to show all graphed data points in the selected range.

Zooming Out of a Graph

▶ Select **Graph > Zoom Out**.

The graph is now expanded.

If a Zoom In precedes a Zoom Out, the graph displays the original settings prior to the Zoom In.

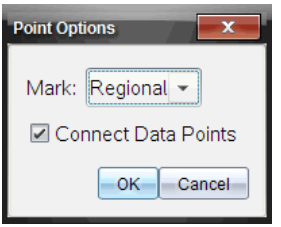
For example, if you Zoomed In twice, the first Zoom Out would display the window of the first Zoom In. To display the full graph with all data points from multiple zoom ins, use Autoscale Now.

Setting Point Options

To indicate how often marks show on the graph and whether to use a connecting line:

1. Click **Options > Point Options**.

   The Point Options dialog box opens.

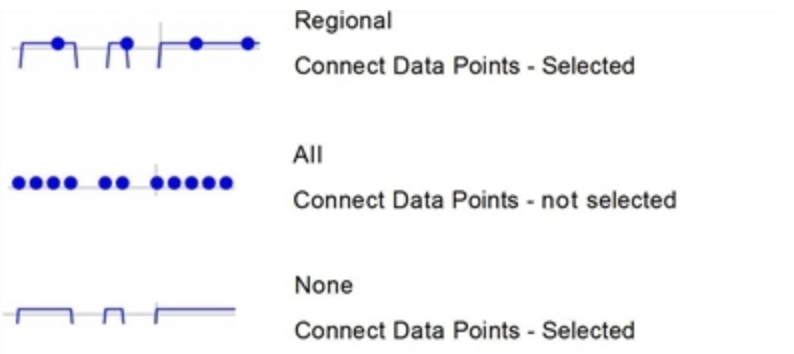


2. Select a **Mark** option from the drop-down list.
   - **None.** No point protectors.
   - **Regional.** Periodic point protectors.
   - **All.** Every data point as a point protector.
3. Select **Connect Data Points** to display a line between points.

   —or—

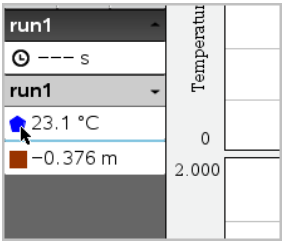
   Clear **Connect Data Points** to remove the line between points.

The following graphics show examples of some of the Point Mark options.



Changing a Graph's Color

1. Click the point indicator for the graph whose color you want to change.



2. In the Column Options dialog box, select the new **Color**.

Selecting Point Markers

1. Right-click in the graph to open the menu.
2. Click **Point Marker**.

   Note: If there is only one dependent variable column, the Point Marker option is preceded by the data set name and column name. Otherwise, the Point Marker option has a menu.

3. Select the column variable to change.
4. Select the point marker to set.

   The Point Marker changes to the option selected.

Selecting an Independent Variable Column

Use the option Select X-axis Column to select the column used as the independent variable when graphing the data. This column is used for all graphs.

1. Click **Graph > Select X-axis Column**.
2. Select the variable you want to change.

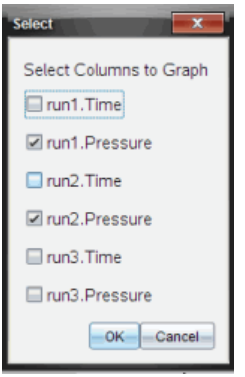
   The x-axis label on the graph changes and the graph is reordered using the new independent variable for graphing the data.

Selecting a Dependent Variable Column

Use the option Select Y-axis Column to select which dependent variable columns to plot on the displayed graph(s).

1. Click **Graph > Select Y-axis Column**.
2. Select one of the following:

- A variable from the list. The list is a combination of dependent variables and the number of data sets.
- **More.** Selecting More opens the Select dialog box. Use this when you want to select a combination of data set variables to graph.



Showing and Hiding Details

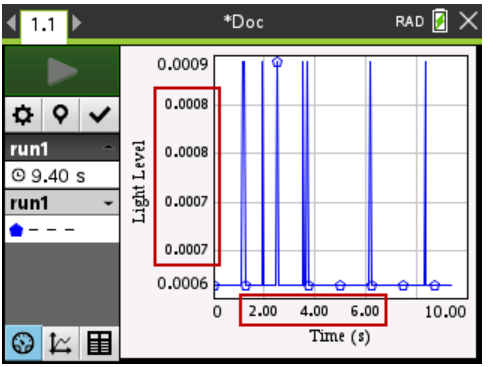
You can hide or show the Details view on the left side of the screen.

▶ Click **Options > Hide Details** or **Options > Show Details**.

Showing and Hiding Axes Tick Labels

You can hide or show the axes tick labels on a graph.

▶ Click **Options > Hide tick labels** or **Options > Show tick labels**.



Notes:

- When a Vernier DataQuest™ application is added to a document, the tick labels will default to being displayed.
- Tick labels may not be displayed if there is a lack of available space. Minimum and maximum values will always be displayed.
- Tick labels cannot be edited, but they will recalculate as needed if the minimum or maximum values are edited or the window settings are changed.

Striking and Restoring Data

Striking data omits it temporarily from the Graph view and from the analysis tools.

1. Open the data run that contains the data to be struck.
2. Click **Table View**  .
3. Select the region by dragging from the starting row to the ending point.

   The screen scrolls so you can see the selection.
4. Click **Data > Strike Data**.
5. Select one of the following:
   - **In Selected Region**. Strike the data from the area you selected.
   - **Outside Selected Region**. Strike all data except the area you selected.

   The selected data is marked as struck in the table and is removed from the graph view.

Restoring Struck Data

1. Select the range of data to restore or if restoring all struck data, start at step two.
2. Click **Data > Restore Data**.
3. Select one of the following:
   - **In Selected Region** - Restore data in the selected area.
   - **Outside Selected Region** - Restore data outside the selected area.
   - **All Data** - Restore all data. No data selection necessary.

   The data is restored.

Replaying the Data Collection

Use the Replay option to playback the data collection. This option lets you:

- Select the data set you want to replay.
- Pause the playback.
- Advance the playback by one point at a time.
- Adjust the playback rate.
- Repeat the playback.

Selecting the Data Set to Replay

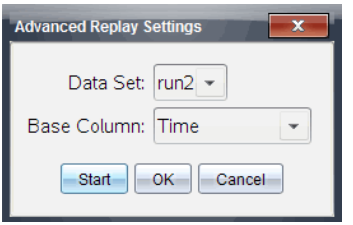
You can replay one data set at a time. By default, the latest data set plays using the first column as the base column (example: time reference).

If you have multiple data sets, and want a different data set or base column than the default, you can select the data set to replay and the base column.

To select the data set to replay:

1. Click **Experiment > Replay > Advanced Settings**.

   The Advanced Replay Settings dialog box opens.



2. Select the data set to replay from the Data Set drop-down list.

   Note: Changing the run in the Data Set selection tool does not affect the playback choice. You must specify which data set in **Experiment > Replay > Advance Settings**.

3. (Optional) Select a new value from the Base Column drop-down list.

   The selected column acts as the “Time” column for the replay.

   Note: The base column should be a strictly increasing list of numbers.

4. Click **Start** to start the playback and save the settings.

   Note: Data Set and Base Column options are based on the number of stored runs and the sensor type used.

Starting and Controlling the Playback

▶ Select **Experiment > Replay > Start Playback**.

Playback begins, and the Data Collection Control buttons change to:

 Pause

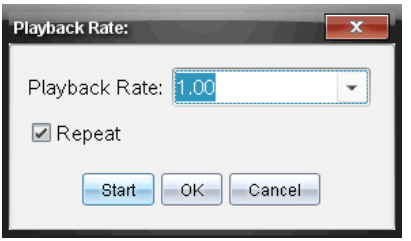
	Resume
	Stop
	Advance by One Point (enabled only during pause)

Adjusting the Playback Rate

To adjust the playback rate:

1. Select **Experiment > Replay > Playback Rate**.

   The Playback Rate dialog box opens.



2. In the Playback Rate field, click ▼ to open the drop-down list.
3. Select the rate at which the playback will play.

   Normal speed is 1.00. A higher value is faster, and a lower value is slower.

4. Select one of the following options:
   - Click **Start** to start the playback and save the settings.
   - Click **OK** to save the settings for use on the next playback.

Repeating the Playback

1. Select **Experiment > Replay > Start Playback**.
2. Click **Start** to start the playback and save the settings.

Adjusting Derivative Settings

Use this option to select the number of points to use in derivative calculations. This value affects the tangent tool, velocity, and acceleration values.

Find pH derivative settings using a calculated column.

The Vernier DataQuest™ application can determine a numeric derivative from a list of data with respect to another list of data. The data can be collected using sensors, input manually, or linked with other applications. The numerical derivative is found using a calculated column.

To determine the numerical 1st derivative of List B with respect to List A, enter the following expression in the Column Options dialog:

`derivative(B,A,1,0) or derivative(B,A,1,1)`

To determine the numerical 2nd derivative of List B with respect to List A, enter the following express:

`derivative(B,A,2,0) or derivative (B,A,2,1)`

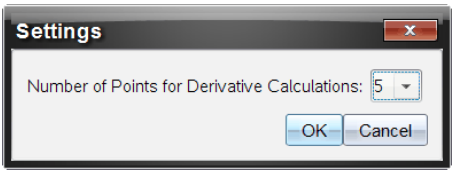
The last parameter is either 0 or 1 depending on the method you are using. When it is 0, a weighted average is used. When it is 1, a time shifted derivative method is used.

Note: The first derivative calculation (weighted average) is what the Tangent tool uses to display the slope at a data point when examining data. (Analyze > Tangent).

Note: The derivative calculation is completely row based. It is recommended that your List A data be sorted in ascending order.

1. Click **Options > Derivative Settings**.

   The Settings dialog box opens.

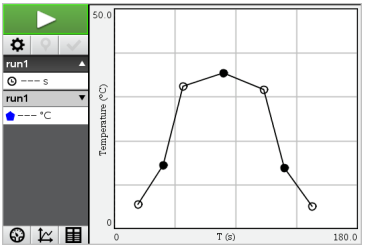


2. Select the number of points from the drop-down list.
3. Click **OK**.

Drawing a Predictive Plot

Use this option to add points to the graph to predict the outcome of an experiment.

1. Click the **Graph View** tab .
2. From the **Analyze** menu, select **Draw Prediction > Draw**.
3. Click each area in which you want to place a point.
4. Press **Esc** to release the drawing tool.



5. To clear the drawn prediction, click **Analyze > Draw Prediction > Clear**.

Using Motion Match

Use this option to create a randomly generated plot when creating position-versus-time or velocity-versus-time graphs.

This feature is only available when using a motion detector such as the CBR 2™ sensor or the Go!Motion® sensor.

Generating a Motion Match Plot

To generate a plot:

1. Attach the motion detector.
2. Click **View > Graph**.
3. Click **Analyze > Motion Match**.
4. Select one of the following options:
   - **New Position Match**. Generates a random position plot.
   - **New Velocity Match**. Generates a random velocity plot.

Note: Continue selecting a new position or a new velocity match to generate a new random plot without removing the existing plot.

Removing a Motion Match Plot

To remove the generated plot:

▶ Click **Analyze > Motion Match > Remove Match**.

Printing Collected Data

You can only print from the computer. You can print any single displayed active view, or with the Print All option:

- One data view.
- All of the data views.
- A combination of the data views.

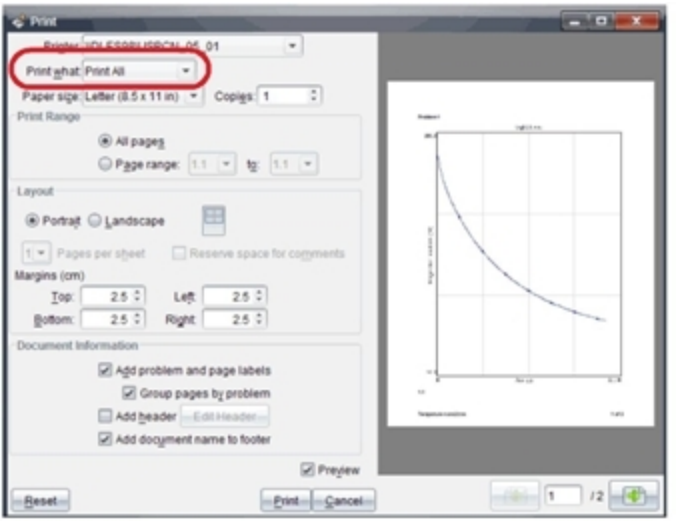
The Print All option has no effect on applications outside of the Vernier DataQuest™ application.

Printing Data Views

To print a data view:

1. On the main menu (top of the window), click **File > Print**.

   The Print dialog box opens.

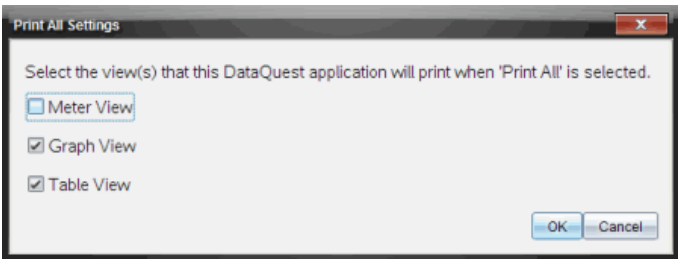


2. Select **Print All** from the Print what drop-down list.
3. Select additional options, if needed.
4. Click **Print** to send the document to the printer.

Setting Options for the Print All Feature

1. Click **Options > Print All Settings**.

   The Print All Settings dialog box opens.



2. Select the views you want to print.
    - **Print Current View.** The current view is sent to the printer.
    - **Print All Views.** All three views (Meter, Graph, and Table) are sent to the printer.
    - **More.** Only the views you select are sent to the printer.
3. Click **OK**.

    The Print All Settings are now complete and can be used when printing.

Data & Statistics Application

The Data & Statistics application provides tools to:

- Visualize sets of data in different types of plots.
- Directly manipulate variables to explore and visualize data relationships. Data changes in one application are dynamically applied to all linked applications.
- Explore central tendency and other statistical summary techniques.
- Fit functions to data.
- Create regression lines for scatter plots.
- Graph hypothesis tests and results (z- and t-tests) based on summary statistics definitions or data.

Adding a Data & Statistics Page

▶ To start a new document with a blank Data & Statistics page:

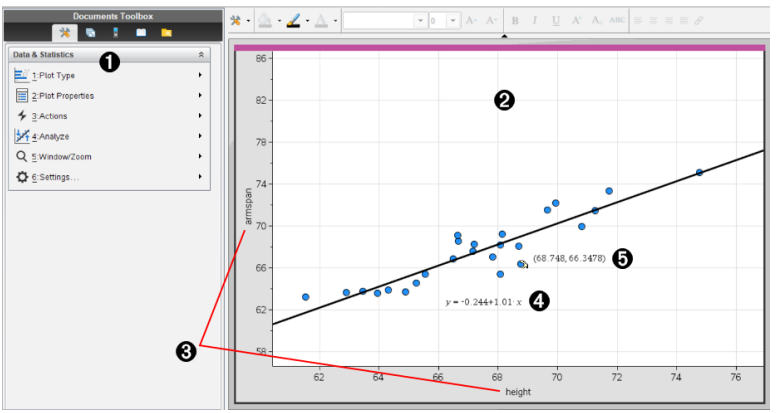
From the main **File** menu, click **New Document**, and then click **Add Data & Statistics**.

Handheld: Press [on], and select **Data & Statistics** .

▶ To add a Data & Statistics page in the current problem of an existing document:

From the toolbar, click **Insert > Data & Statistics**.

Handheld: Press [doc] and select **Insert > Data & Statistics**.



❶ Data & Statistics menu

❷ Work area

❸ **Add Variable** regions on x-axis and y-axis

❹ Linear Regression Plot with expression

❺ Data point with coordinates

Basic Operations in Data & Statistics

The Data & Statistics application lets you explore and visualize data and graph inferential statistics. The Lists & Spreadsheet application can work in conjunction with the Data & Statistics application. The Lists & Spreadsheet Summary Plot and Quick Graph tools automatically add a Data & Statistics application to show plots. A list that you create in a problem (using the Lists & Spreadsheet or Calculator applications) can be accessed as a variable in any TI-Nspire™ application in that problem.

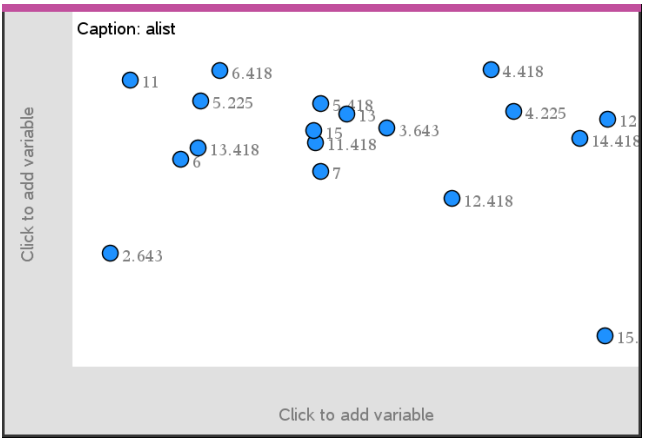
Changing Data & Statistics Settings

1. From the **Settings** menu, select **Settings**.
2. Select the settings that you want to use.
   - **Display Digits.** Lets you select the display format for numeric labels in the current document. Select **Auto** to automatically follow the setting in the Document Settings dialog box.
   - **Diagnostics.** Displays the value of the r^2 or R^2 statistic (when available) under certain regression equations.
     - r^2 is displayed for Linear (mx+b), Linear (a+bx), Power, Exponential, and Logarithmic regressions.
     - R^2 is displayed for Quadratic, Cubic, and Quartic regressions.

Using the Default Caseplot

The Data & Statistics application plots numeric and string (categorical) data from variables. When you add a Data & Statistics application to a problem that includes lists, a default caseplot displays on the work area.

The caseplot is like having a stack of cards with information on them and scattering the cards randomly on a table. You can click a dot to see the information on that “card.” You can drag a dot to “group” the “cards” by the caption variable.



▶ Click the variable name displayed after **Caption** to use the caseplot.

- Choose <None> to remove the default caseplot.
- Choose the name of a variable to have it replace the current caseplot variable.
- Hover over any data point to see the summary information.
- Drag any data point toward an axis to see how the points group.
- Activate the Graph Trace tool and press ◄ or ► to move across points.

When you add a variable to either axis, the plot for that variable replaces the default caseplot. The default caseplot redisplays if you remove the plotted variable from each axis.

Using the Context Menu

The context menu provides access to the tools most commonly used with the selected object. The context menu displays different options depending on the active object and the task you are performing.

▶ To open the context menu for an object.

Windows®: Right-click the object.

Mac®: Hold ⌘ and click the object.

Handheld: Point to the object and press ctrl menu.

The context menu includes the **Color** option. You can use the Color option to change the data to the color of your choice.

Other options that are appropriate for various plots also appear on the context menu.

Selecting Data and Displaying Summary Information

When you hover over part of a plot, the Data & Statistics application displays summary information for the data it represents.

1. Hover at an area of interest in a plot to display data values or summary information. For example, you can hover over the center of a box plot to display the median summary data.
2. Click once to select a representation of data in a plot.

   Data points are shown with a bold outline to indicate selection. You can click a point a second time to deselect it, or click additional points to add to the selection.

Plotting Variables

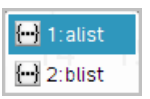
To plot variables, start with a problem that includes a Data & Statistics application and lists created in the Lists & Spreadsheet application or the Calculator application.

1. Click the Add Variable region near the center of an axis.

   If no variable is plotted on the axis, the tooltip **Click or Enter to add variable** displays.

2. Click the tooltip **Click or Enter to add variable**.

   A list displays the names of available variables.

3. Click the name of the variable to plot.

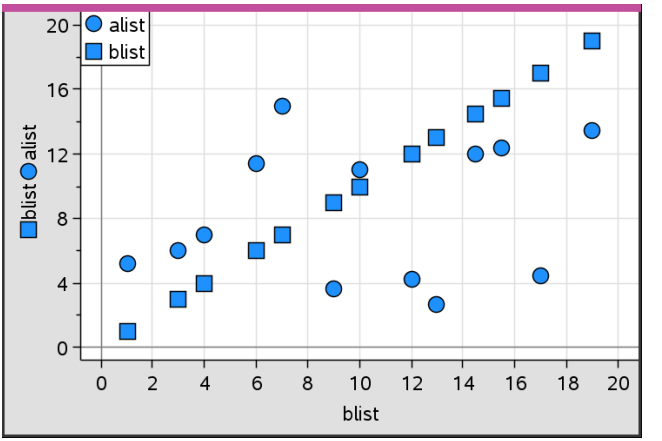
   Note: By convention, the independent variable is shown on the x-axis.

   The default plot for one variable is a dot chart. The data points in the default caseplot reposition to represent the elements of the selected variable in a dot chart.

4. (Optional) Click the Add Variable region near the center of the remaining axis to plot a second variable.

   The default plot for two variables is a scatter plot. The data points shift to represent the elements of both variables as a scatter plot.

5. (Optional) Repeat Steps 1-3 to choose additional variables to plot on the vertical axis.



The name of each variable that you add is appended to the label on the axis. The default data point shape changes to help you distinguish data, and a legend is displayed to identify the shapes.

6. Change, analyze, or explore the plotted data.
   - Remove or change the variable on an axis by clicking the Add Variable region again.
   - View the plotted data in another supported plot type by selecting a tool from the **Plot Types** menu.
   - Choose the Graph Trace tool on the **Analyze** menu and press ◄ or ► to move across the data points in the plot.
   - The lists that you plot as variables can include incomplete or missing cases. (A case is the data contained in a row of cells in the Lists & Spreadsheet application.) The Lists & Spreadsheet application displays a void as an underscore ("_"), and Data & Statistics plots no data point for a void cell.

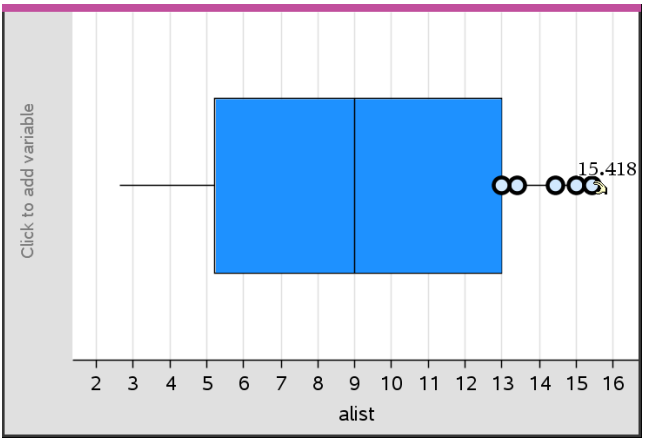
Manipulating Plotted Data

You can manipulate data points on the Data & Statistics work area to explore their effects. For example, you could explore how a specific group of values affects the median.

You can move a data point only in directions allowed by its definition. If a list is defined with a formula in Lists & Spreadsheet, the points in Data & Statistics may not move because of the formula's restrictions. For example, you can manipulate a plot that represents the result of y=x, but you can only move along a line.

You cannot move points that represent data in a locked variable or data that represents a categorical value.

1. On the Data & Statistics work area, click a representation of data—such as a histogram bin or a whisker of a box plot—that is not locked or restricted by a formula.



   The pointer changes to an open hand to show that the data can be moved.

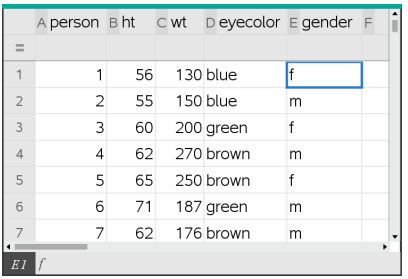
2. Drag the selection to explore how different values of the point affect the plot.

   Handheld: Press ctrl to grab, and then swipe or use the arrow keys to drag.

   As you drag, the changing value displays on the work area.

Overview of Raw and Summary Data

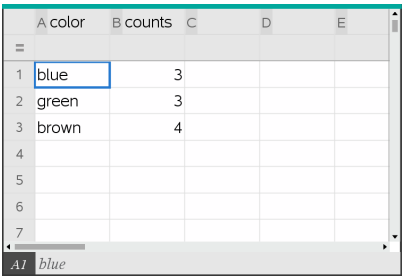
You can create plots directly from raw data or from a summary table.



	A person	B ht	C wt	D eyecolor	E gender	F
1	1	56	130	blue	f	
2	2	55	150	blue	m	
3	3	60	200	green	f	
4	4	62	270	brown	m	
5	5	65	250	brown	f	
6	6	71	187	green	m	
7	7	62	176	brown	m	

E1 f

Raw data



	A color	B counts	C	D	E
1	blue	3			
2	green	3			
3	brown	4			
4					
5					
6					
7					

A1 blue

Summary table for eye color based on raw data

- Raw data consists of a single list, such as a list of eye colors. When you create a plot of raw data, Data & Statistics counts the occurrences for you. Plotting raw data directly gives you flexibility in analyzing it.
- A summary table consists of two lists, such as eye colors (the X or Y List) and counts of eye-color occurrences (the Summary List). For more information, see *Using Lists & Spreadsheet* chapter.

Working with Numeric Plot Types

Plots can represent the data from a variable in a variety of ways. Choosing the appropriate plot can help you visualize the data. For example, you may be able to observe the shape and spread of the data in one plot type and another type may be useful for determining the best method for statistically evaluating data.

Creating Dot Plots

Dot plots, also known as dot-frequency plots, represent one-variable data. Dot plots are the default plot type for numeric data. When you plot a variable as a dot plot, one dot represents each value in the list. Each dot displays on the axis at a point that correspond to the value.

1. To create a dot plot, click the Add Variable region in the center of an axis and click the name of a numeric variable. For more information, see *Plotting Variables*.
2. (Optional) To split a dot plot by category, click the Add Variable region on the other axis and choose the list that contains the corresponding category data.
3. (Optional) To plot multiple dot plots, choose **Add X Variable** on the **Plot Properties** menu and click a numeric variable from the list that displays.

   A second dot plot appears on the work area and the name of the plotted variable is added to both axis labels.
4. Explore the plotted data.

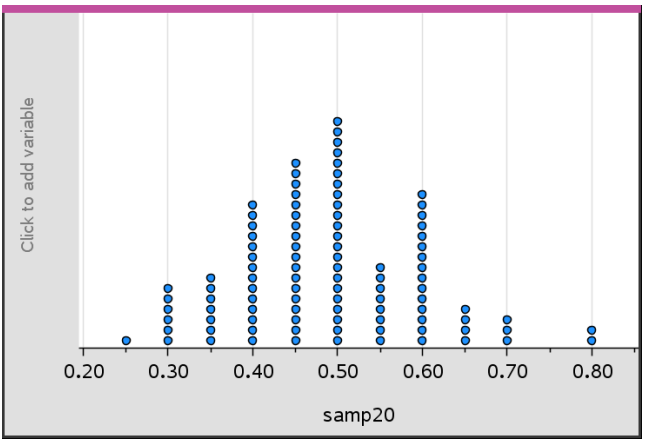
- Hover over a data point to display data values.
- Drag a dot to move it. As you move a point, the values associated with it change on the work area display and in the list for the variable.
- Activate the Graph Trace tool and press ◄ or ► to move across the data points in the plot in list order. Points enlarge and display a bold outline as you move across them in Trace mode.

Creating Box Plots

The Box Plot Tool plots one-variable data in a modified box plot. “Whiskers” extend from each end of the box, either to 1.5 times the interquartile range or to the end of the data, whichever comes first. Points that are a width of 1.5 * Interquartile Range past the quartiles plot individually, beyond the whiskers. These points are the potential outliers. When no outliers exist, x-min and x-max are the prompt for the end of each whisker.

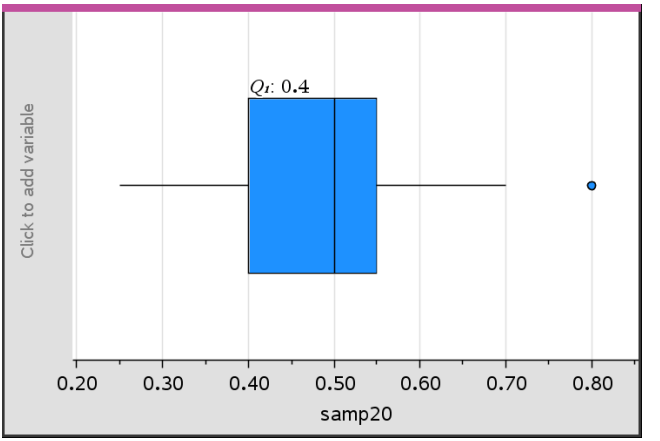
Box plots are useful for comparing two or more sets of data that use the same scale. If a dataset is large, a box plot can also be useful in exploring data distribution.

1. Click the Add Variable region in the center of an axis. The default plot for one numeric variable is a dot plot. For more information, see *Plotting Variables*.



   Note: If two variables are plotted in the work area, you can create a dot plot by removing one variable. Choose **Remove X Variable** or **Remove Y Variable** from the **Plot Types** menu.

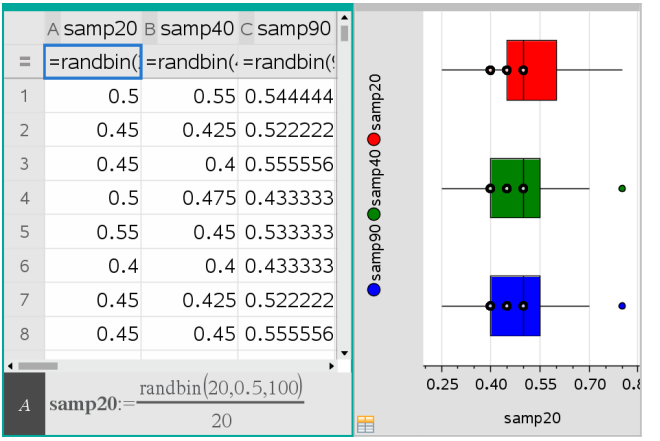
2. On the **Plot Types** menu, click **Box Plot**.



A modified box plot displays on the Data & Statistics work area.

Note: You can split a box plot by category by adding a list that contains corresponding categorical data to the y-axis.

3. (Optional) To add additional variables for comparing box plots on the same axis, click **Add X Variable** on the **Plot Properties** menu.



For example, you can use multiple box plots to compare the distributions of sample proportions. In the example, true proportion is .5 and sample size varies from n=20 to n=40 to n=90.

Notes:

- You can create a box plot with frequency by choosing **Add X Variable** or **Add Y Variable** on the **Plot Properties** menu.
- You can specify a variable multiple times as you choose variables to plot as box plots.
- The variable used to provide frequency information is added to the label on the horizontal axis in the format: *x_variablename*{*frequencylist_name*}.

4. Point and click the regions of the box plot to explore and analyze the data it represents.
   - Hover over a region or over a whisker to display the details for the portion of the plot that interests you. The label for the quartile that corresponds to your selection is displayed.
   - Click a region of the box plot to select the data points or whiskers. Click again to remove the selection.
   - You can select any box plot that does not include frequency data and choose **Dot Plot** on the context menu to change the plot type.
   - Drag a selection to move it and explore other possibilities for the data.
   - Use the arrow keys to move a data point one pixel at a time.
   - Activate the Graph Trace tool and press ◄ or ► to move across dots and regions of the plot. As the trace cursor moves, the values for Q1, the median, Q3, and whisker ends/outliers are displayed.
5. Change the plot from a modified box plot to a standard box plot by choosing **Extend Box Plot Whiskers** on the **Plot Properties** menu.

   The box plot is redrawn as a standard box plot with extended whiskers.

   The standard box plot's whiskers use the minimum and maximum points in the variable and outliers are not identified. The whiskers on the plot extend from the minimum data point in the set (x-min) to the first quartile (Q1) and from the third quartile (Q3) to the maximum point (x-max). The box is defined by Q1, Med (median), and Q3.

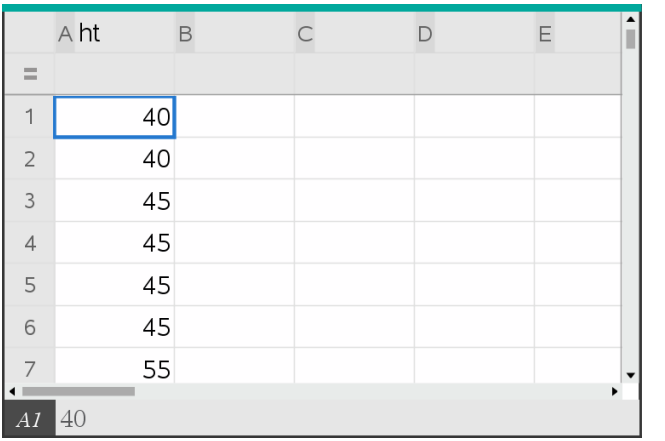
   Note: You can click **Show Box Plot Outliers** on the **Plot Properties** menu to return to the modified box plot.

Plotting Histograms

A histogram plots one-variable data and depicts the distribution of data. The number of bins displayed depends on the number of data points and the distribution of these points. A value that occurs on the edge of a bin is counted in the bin to the right.

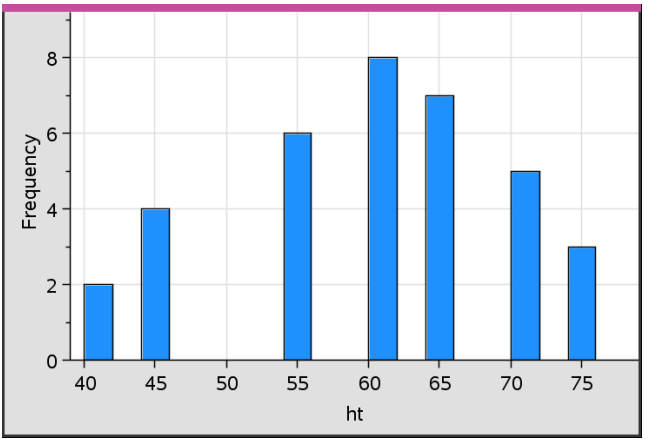
Creating a Histogram from Raw Data

1. Create the list that you want to plot as a histogram. For example, you can enter or collect data as a named list on a Lists & Spreadsheet page.



2. On a Data & Statistics page, click the x or y axis, and select your list as the data to plot.
3. From the **Plot Types** menu, click **Histogram**.

   The data forms the bins of a histogram, with Frequency plotted by default on the unselected axis.



4. Explore the data.
   - Hover over a bin to see the information for that bin.
   - Click a bin to select it. Click the bin again to deselect it.
   - Drag the side of a bin to adjust bin width and number of bins.

     Note: The bins are not adjustable in categorical plots or plots in which you choose variable bin widths.

   - On the **Analyze** menu, click **Graph Trace** and press ◄ or ► to cycle through the bins and display their values.

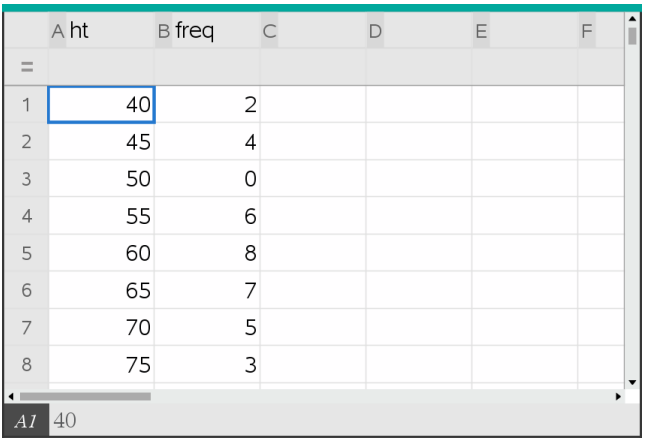
Adjusting the Histogram Scale of Raw Data

1. On the **Plot Properties** menu, click **Histogram Properties** and choose **Histogram Scale**.

2. Choose the format for the scale of the histogram.
   - **Frequency** - displays data based upon the number of values that occur within each bin. This is the default data representation.
   - **Percent** - displays data in the histogram by each group's percent value of the whole data set.
   - **Density** - displays data based upon the density of each group within the data set.

Creating a Histogram with Frequency or Summary Data

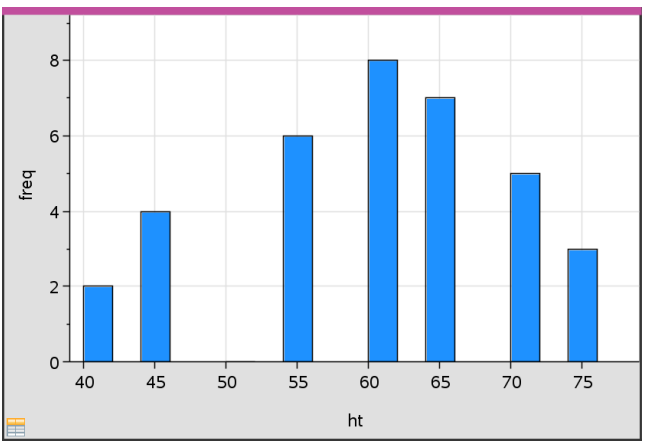
1. On a Lists & Spreadsheet page, create two lists: one containing the "bins," such as heights in a population (*ht*), and the other containing the frequencies of those heights (*freq*).



	A ht	B freq	C	D	E	F
1	40	2				
2	45	4				
3	50	0				
4	55	6				
5	60	8				
6	65	7				
7	70	5				
8	75	3				

A1 40

2. On a Data & Statistics page, access the context menu on the x axis, and click **Add X Variable with Summary List**.
3. Select *ht* as the X List and *freq* as the Summary List.



Note: It is up to you to set the data and bins in a meaningful way when using summary data.

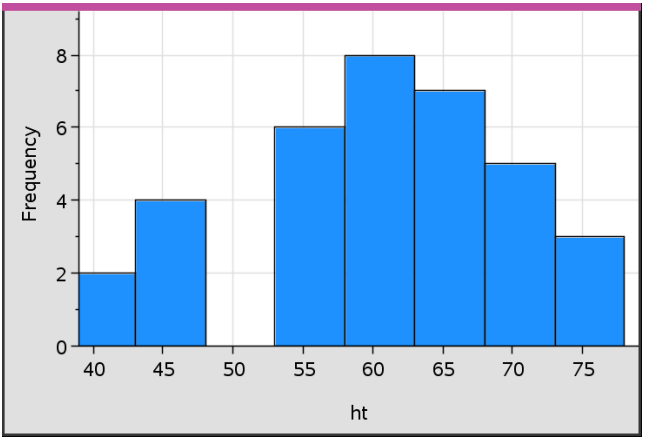
Setting Equal Bin Widths

By default, bin widths are set to equal. You can specify the width and alignment of equal-width bins.

1. On the **Plot Properties** menu, click **Histogram Properties > Bin Settings**, and choose **Equal Bin Width**.

   The **Equal Bin Width Settings** dialog box opens.

2. Type values to set **Width** and **Alignment** of the bins.
3. Click **OK** to apply the changes and redraw the bins.



   Both the data represented by the bins and the value you type for the alignment affect the placement of bins on the scale.

Setting Variable Bin Widths

You can set variable bin widths based on a list of bin boundaries.

1. Create a named list containing boundary values.

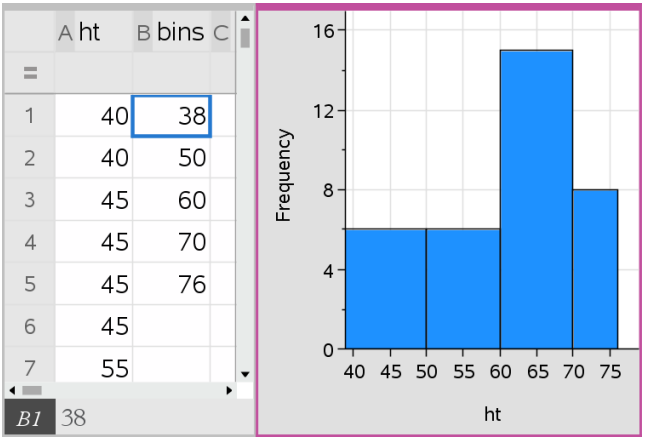
   For example, a boundary list defined as {60,70,100,110} will create bins at 60 to 70, 70 to 100, and 100 to 110.

   Note: The data must fall within the specified bin widths. For example, a data point of 115 would be outside the bins in the above list, and you would receive a Data/Bin Location Mismatch error.

2. On the **Plot Properties** menu, click **Histogram Properties > Bin Settings**, and choose **Variable Bin Width**.

The **Variable Bin Width Settings** dialog box opens.

3. Select your boundary list as the **List of Bin Boundaries**.
4. Click **OK** to apply the changes and redraw the bins.



Note: You cannot change variable bin widths by dragging their boundaries; you must edit the list of boundaries or restore equal-width bins.

Creating a Normal Probability Plot

A normal probability plot shows one set of data against the corresponding quartile (*z*) of the standard normal distribution. You can use normal probability plots to judge the appropriateness of the normal model for your data.

1. Choose or create the data you want to use for a normal probability plot. Use a named list from Lists & Spreadsheet or Calculator.
2. Plot the data in one of the following ways:
   - Create a dot plot by selecting a column and choosing **Quick Graph**.
   - Add a Data & Statistics work area. Click the Add Variable region on an axis and click the data list name to plot the variable.
3. On the **Plot Types** menu, click **Normal Probability Plot**.

   The data graphs in the Data & Statistics work area. You can examine the graph to compare the normal variable against the quartile.
4. Explore the data represented in the normal probability plot.
   - Hover over a data point to display its value.

- Click to select a data point. Click again to deselect it.
- Click multiple data points to select them.
- Activate the Graph Trace tool and press ◄ or ► to move across the data points and display values.

Creating a Scatter Plot

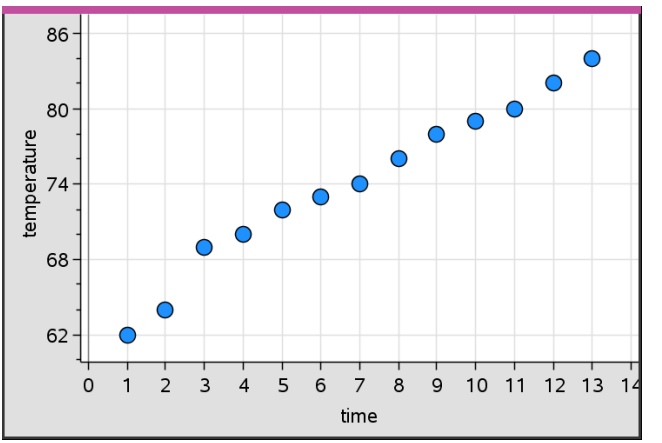
A scatter plot shows the relationship between two sets of data. You can also plot a scatter plot by using the Quick Graph tool in the Lists & Spreadsheet application.

1. In the Data & Statistics work area, click the Add Variable region and select the variable that contains the data you want to see represented on an axis.

   The plot of the selected variable displays on the axis.

2. Click the Add Variable region of the other axis and select the variable containing the data you want to plot.

   The data points shift to represent the data in the selected variable.



3. Analyze and explore the data in the plot.
   - Click a point to select it.
   - Hover over a data point to view the summary data.
   - Work with the data using the available tools on the **Analyze** menu. For example, choose the Graph Trace tool and press ◄ or ► to move across the plot.
4. Optional: To plot additional lists against the x-axis, right-click the y-axis and click **Add Variable**.

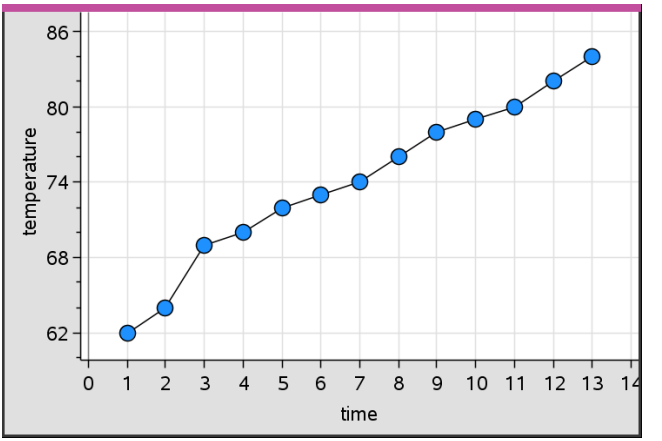
Creating an X-Y Line Plot

An X-Y line plot is a scatter plot in which the data points are plotted and connected in order of appearance in the two variables. Like scatter plots, these plots depict the relationship between two sets of data.

By convention, the left-most column of data is represented on the horizontal axis.

1. Create a scatter plot. For more information, see *Creating a Scatter Plot*.
2. On the **Plot Types** menu, click the **XY Line Plot** tool.

   The data points within each set are connected to each other by a line.



   Note: The dots are connected in the order that they appear in the list variable on the horizontal axis. To change the order, use the sort tool in Lists & Spreadsheet.

3. Analyze and explore the data in the plot.
   - Hover over a data point to view the summary data.
   - Work with the data using the available tools on the **Analyze** menu. For example, choose the Graph Trace tool and press the arrow keys to move across the dots in the plot and view the values.

Working with Categorical Plot Types

You can sort and group data using the categorical plot types:

- Dot Chart
- Bar Chart
- Pie Chart

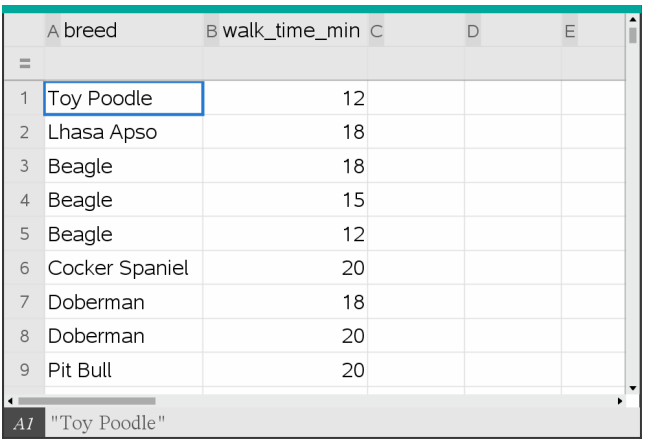
The categorical plot types can be used to compare the representations of data across different plots. When the same variable (list) is used for a dot chart and a bar chart or pie chart in a problem, selecting a data point or segment in one of the plots selects the corresponding data point, segment, or bar in all other plots that include the variable.

Creating a Dot Chart

The default plot type for categorical data is the dot chart.

When one variable is plotted, the value of each cell is represented as one dot, and the dots are stacked at the point on the axis that corresponds to the cell value.

1. In Lists & Spreadsheet, create a spreadsheet that includes at least one column of string values that can be used as categories for data.



	A breed	B walk_time_min	C	D	E
=					
1	Toy Poodle	12			
2	Lhasa Apso	18			
3	Beagle	18			
4	Beagle	15			
5	Beagle	12			
6	Cocker Spaniel	20			
7	Doberman	18			
8	Doberman	20			
9	Pit Bull	20			

A1 "Toy Poodle"

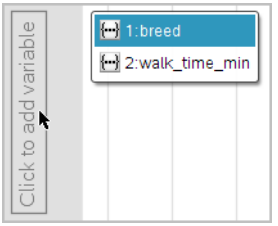
   Note: To type a string in Lists & Spreadsheet, enclose the characters in quotes.

2. Add a Data & Statistics page to the problem.

   Notes:

   - You can also use the Lists & Spreadsheet Quick Graph tool to automatically add a Data & Statistics page and plot the selected column.
   - The new Data & Statistic work area displays a default caseplot with a caption, variable name, and unplotted data points for the variable. You can click the variable name in the caption to choose another variable for previewing, or drag a default data point toward an axis to plot the current variable.

3. Move near the center of either axis and click the Add List region. The list of variables displays.



4. Click the list that contains the categories you want to use for sorting data.

A dot chart plots in the work area. The application labels the axis with the variable name and shows a dot for each instance of a category.

5. Explore the plotted data.
   - Hover over a dot in the plot to display data values.
   - Click a dot to select it. Click the dot a second time to deselect it or remove it from a selection of multiple dots.
   - Activate the Graph Trace tool and press ◄ or ► to move across the points in list order. Dots display a bold outline as you move across them in Trace mode.

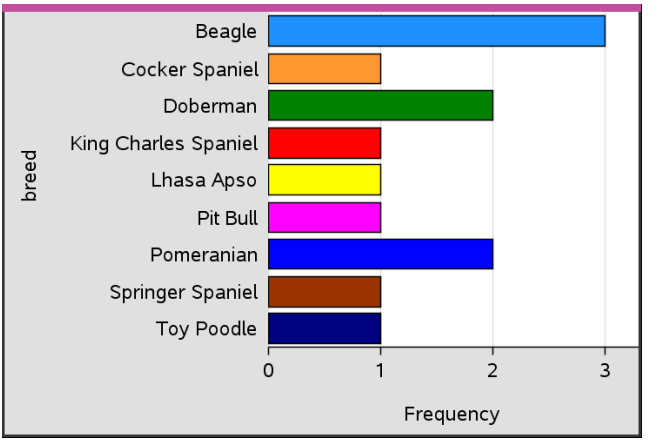
Creating a Bar Chart

Like dot charts, bar charts display categorical data. The length of a bar represents the number of cases in the category.

1. Click the Add Variable region of either axis and choose the name of a categorical variable. For more information, see *Creating a Dot Chart*.

2. On the **Plot Types** menu, click **Bar Chart**.

   The dot chart changes to a bar representation of the data.



3. Explore the data in the plot.
   - Hover over a bar to see a category summary (the number of cases and percentage among all categories).
   - Activate the Graph Trace tool and press ◄ or ► move across the bars and view summary information.

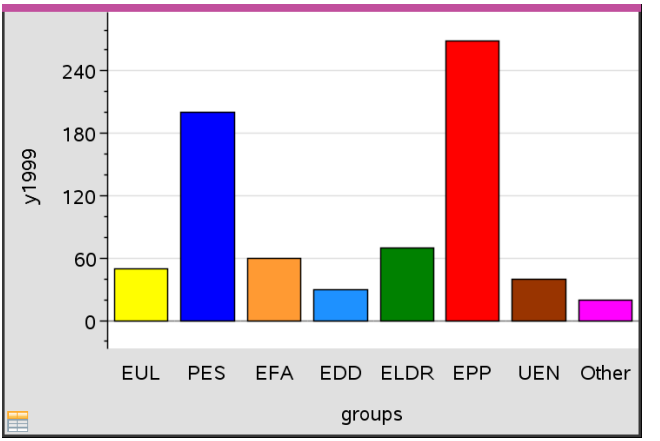
Creating a Bar Chart from a Frequency Table or Summary Data

1. On a new Data & Statistics page, create a bar chart with frequency or summary data by choosing **Add X Variable** on the **Plot Properties** menu.

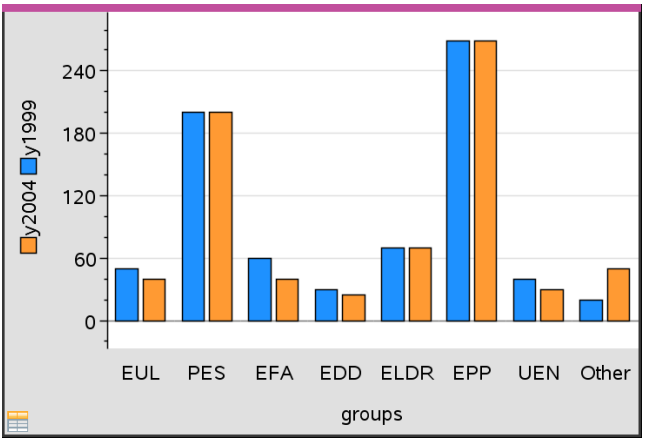
   Note: You can also create a bar chart with frequency by selecting **Add Variable with Summary List** from the context menu of the Add Variable region of an axis.

2. Select the desired variable from the pop-up choices.
3. Set the height of the bars with the summary variable by selecting **Add Summary List** from the **Plot Properties** menu.
4. Select the summary list from the pop-up choices.

   The bar chart plots on the work area. The icon in the lower left corner indicates that this plot was generated from summary data.



5. Hover over a bar to see a category summary, or use the Graph Trace tool on the **Analyze** menu to move across all of the bars displaying the summaries.
6. (Optional) Add summary lists to create a comparative bar chart.

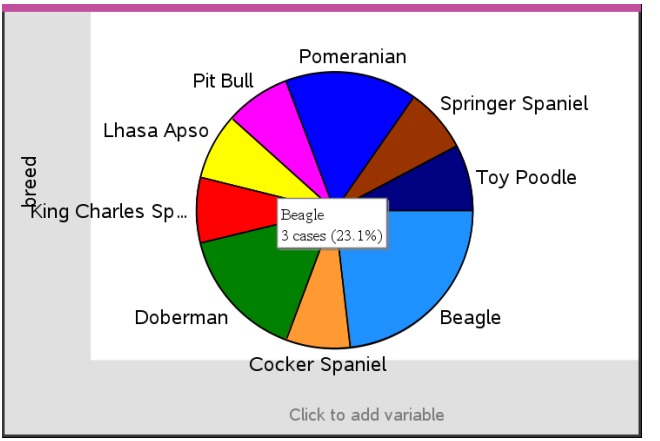


Creating a Pie Chart

A pie chart represents categorical data in a circular layout and uses an appropriately proportioned segment for each category.

1. Create a dot chart on the work area.
2. On the **Plot Types** menu, click **Pie Chart**.

   The dots move by category into the segments of the pie chart.



3. Hover over a segment to see the summary for the category, or use the Graph Trace tool on the **Analyze** menu to move across each segment displaying all of the summaries. The summary shows the number of cases for the category and the percentage among all cases.

Note: You can switch to a pie chart from a bar chart generated from summary data.

Creating a Comparative Bar Chart

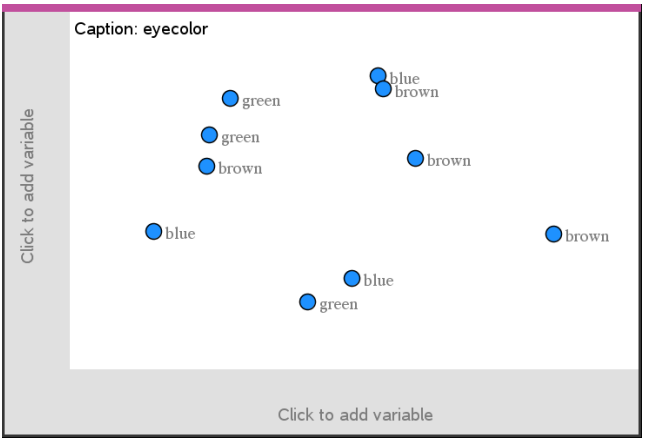
This might be used to explore data in a two-way table.

1. Type the raw data on a Lists & Spreadsheet page.

	A person	B ht	C wt	D eyecolor	E gender	F
1	1	56	130	blue	f	
2	2	55	150	blue	m	
3	3	60	200	green	f	
4	4	62	270	brown	m	
5	5	65	250	brown	f	
6	6	71	187	green	m	
7	7	62	176	brown	m	

E1 *f*

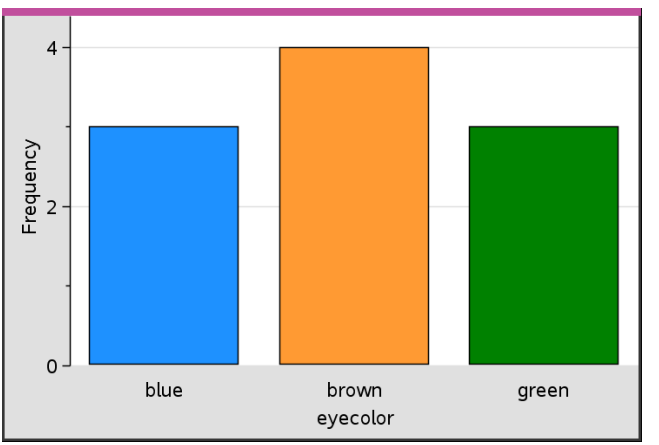
2. From the **Insert** menu in the toolbar, click **Data & Statistics**.



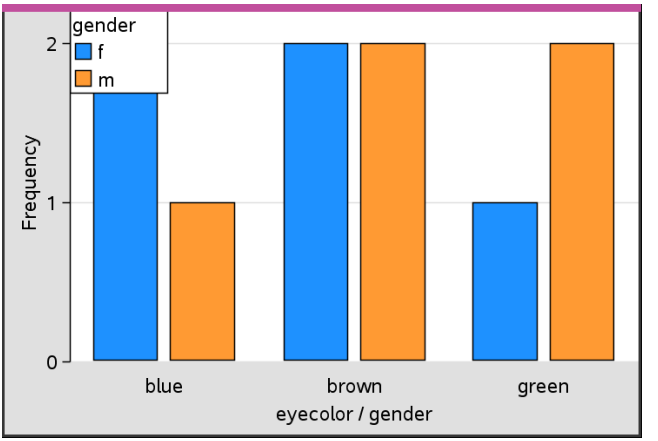
Note: Your screen may differ, depending on the data you entered.

3. Select the **Click to add variable** field, and select **eyecolor** as the variable for the x axis.
4. On the **Plot Type** menu, click **Bar Chart**.

   The frequency of the eyecolor data is plotted.



5. To split the eyecolor data by gender, click the **Plot Properties** menu, click **Split Categories by Variable**, and then click **gender**.



Splitting a Numeric Plot by Categories

You can use a categorical split to sort the values plotted on an axis.

1. Open a problem that includes a Lists & Spreadsheet page, or create data to be plotted in the Lists & Spreadsheet application.

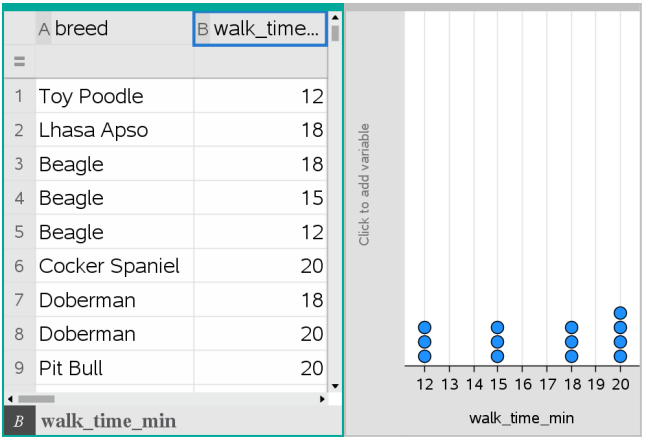
   In this example, lists contain dog breed and daily walk information.

	A breed	B walk_time_min	C	D	E
1	Toy Poodle	12			
2	Lhasa Apso	18			
3	Beagle	18			
4	Beagle	15			
5	Beagle	12			
6	Cocker Spaniel	20			
7	Doberman	18			
8	Doberman	20			
9	Pit Bull	20			

A1 "Toy Poodle"

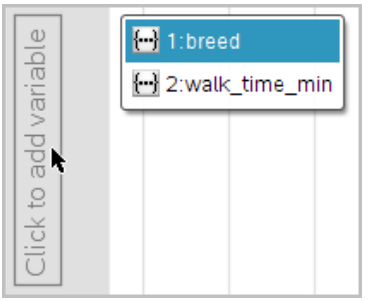
2. Click column letter (B).
3. On the Lists & Spreadsheet **Data** menu, click the **Quick Graph** tool.

The Quick Graph tool adds a Data & Statistics page. Data & Statistics plots the variable and labels the horizontal axis.



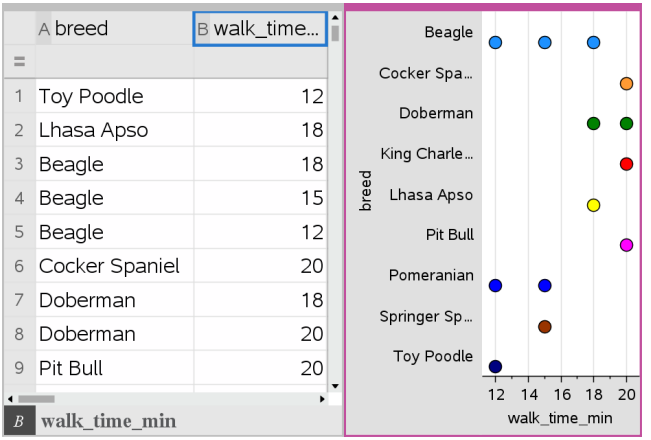
4. To plot the numeric data for each category, hover on the Add Variable region near the center of the vertical axis and click the tooltip **Click or Enter to add variable**.

   The list of available variables displays.



5. On the list of variables, click the name of the category variable.

   Data & Statistics labels the vertical axis and plots the numeric data for each category.



Exploring Data

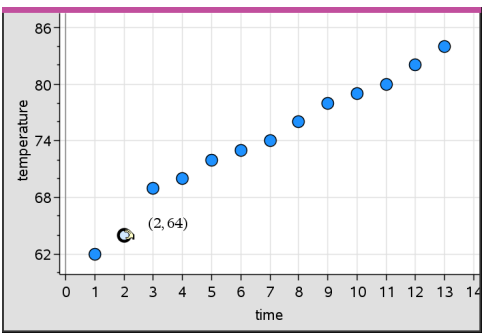
You can manipulate and explore plotted data.

Moving Points or Bins of Data

1. Click and hold the desired point or bin.

   The pointer changes to an open hand .

2. Drag the point or bar to the new location and release it. Moving the point changes the values for x and y.

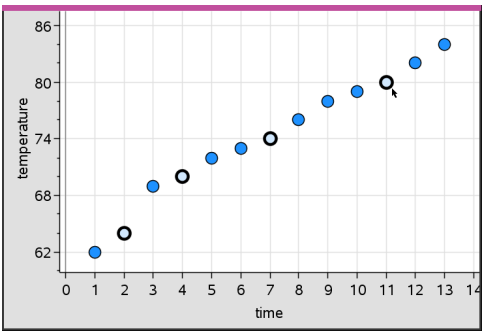


   If you are working with data from Lists & Spreadsheet, the data that corresponds to the original point or bar automatically updates in the original column(s) in Lists & Spreadsheet as you move the point.

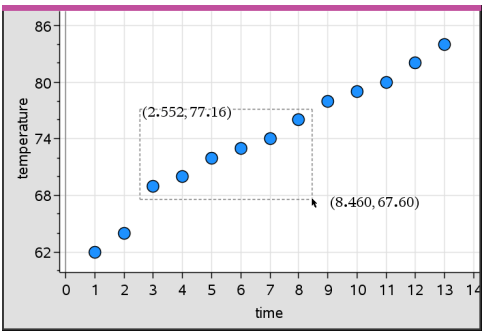
You can also move points or bins by changing the numbers in the Lists & Spreadsheet or Calculator applications. Data will update in all of the representations.

Moving Multiple Points

1. Position the pointer over each data point that you want to select. When the pointer changes to an open hand, click to add the point to the selection.



Alternatively, you can drag a selection rectangle around the points to select them.



2. Drag any of the selected points to move them all.

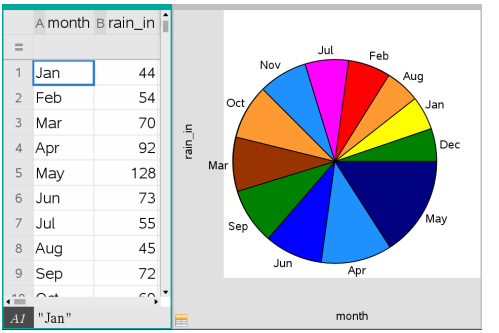
Note: When a list is defined in Lists & Spreadsheet as a formula, the movement of points is restricted to positions that satisfy the formula.

Sorting Plotted Categories

You can sort plotted categories in list order, value order, or alphabetically by category name.

1. Click the work area that contains the plotted data.

2. On the Actions menu, click Sort, and then click the type of sort.



Months listed chronologically but sorted by value (amount of rainfall)

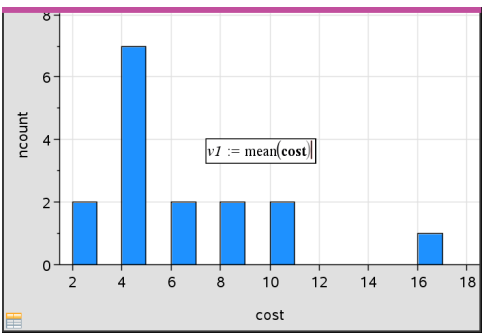
Note: You can customize the order of the categories by clicking a label and dragging it.

Plotting a Value

You can plot a value on an existing plot. It displays as a vertical line in the work area.

1. From the **Analyze** menu, click **Plot Value**.

   A text box with a default expression opens in the work area.



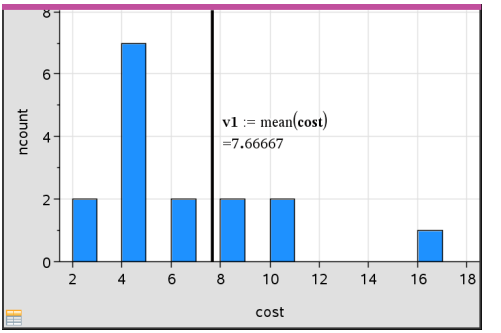
2. Type the value you want to plot, and press **Enter**. In this example, the value is v1:= mean(cost).

   The line is drawn at that value, perpendicular to the axis. If you have multiple plots on the work area, a plot value segment displays for each plot.

Note: If you use a frequency table to generate a histogram, reference the frequency list in your expression. For example, type the expression "v1:= mean(List, FreqList)" in the plot value entry box.

3. Click the line to display the value.

   Note: Double-click the value to edit the expression.



Plot value with value displayed

You can use Plot value for a single number or any expression that evaluates to a number. If the value is dependent on the data, like **mean**, when you drag a point or make changes in the Lists & Spreadsheet application, the line updates to reflect the change, allowing for investigation of the influence of points on the calculation.

Removing a Plotted Value

1. Select the plotted value line.
2. From the **Actions** menu, click **Remove Plotted Value**.

Changing the Plot Type

You can change the plot type, to view different representations of data.

▶ On the **Plot Type** menu, click a new plot type. Only the supported plot types are available. For example, only univariate plot types are available when a single variable plotted on an axis.

The data representation changes to the new plot format.

Note: Options are unavailable on the menu if the plotted data cannot be represented by the plot type. For example, if a scatter plot is displayed in the work

area, you cannot create a box plot without first removing the variable from the y-axis.

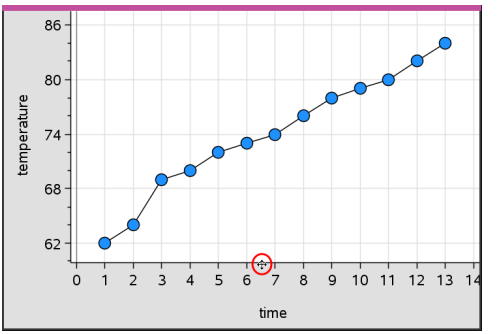
Rescaling a Graph

You can change the scale of the axes by using Translation and Dilation. The pointer changes to indicate whether Translation (✣) or Dilation (⇹) is available in zones on the axes.

Translation

A translation slides a set of axes a fixed distance in a given direction. The original axes have the same shape and size.

1. Position the pointer over a tic mark or label in the middle third of the axis. The pointer changes to ✣.

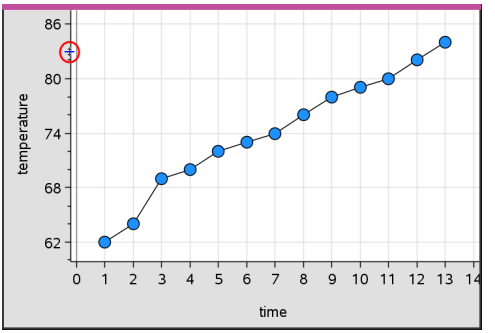


2. Click to grab. The pointer changes to a grasping hand ✊. Drag to the desired position and release.

Dilation

Dilation retains the shape of the axes, but enlarges or reduces the size.

1. Position the pointer over a tic mark or label near the ends of the axis. The pointer changes to ⇳ on the vertical axis or ⇹ on the horizontal axis.



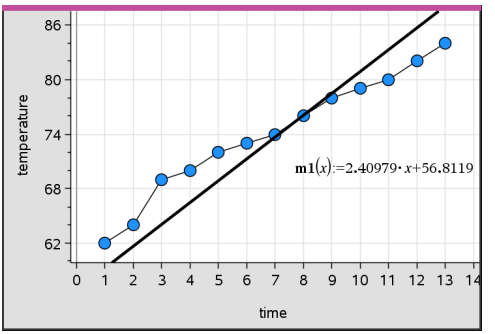
2. Click to grab. The pointer changes to an open hand. Drag to the desired position and release.

Adding a Movable Line

You can add a movable line to a plot. Moving and rotating the line on the work area changes the function that describes it.

▶ From the **Analyze** menu, click **Add Movable Line**.

The movable line displays and is labeled with a function that describes it. For this example, Data & Statistics stores the expression for the movable line in the variable *m1*.

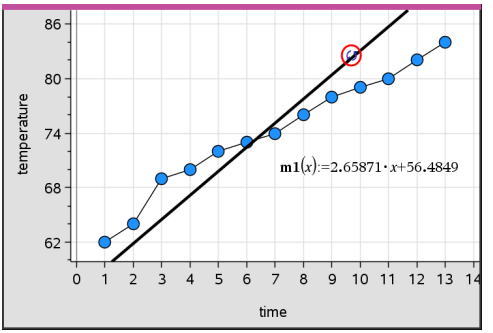


Rotating a Movable Line

1. Click and grab either end of the line.

   The pointer changes to .

2. Drag to rotate and change the slope of the line.



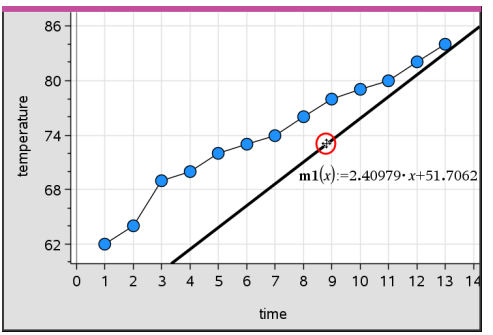
The function m1(x) is updated for the changes in the position of the movable line.

Changing the Intercept

1. Click in the middle of the movable line.

   The pointer changes to ✣.

2. Drag to change the intercept.



The number at the end of the equation changes to show the change in the intercept.

Note: The movable line is stored as a function that can be used for prediction in the Calculator application.

Locking the Intercept at Zero

You can lock the intercept of the movable line at zero.

▶ From the **Analyze** menu, click **Lock Intercept at Zero**.

You can unlock the intercept by choosing **Unlock Movable Line Intercept** on the **Analyze** menu.

Tracing a Movable Line

You can trace a movable line to predict and analyze values.

1. Click the line.

   The pointer changes.

2. From the **Analyze** menu, click **Graph Trace** to enable Trace mode for the line. Rotation of the line is not supported in Trace mode.

3. Press ◄ or ► (left or right arrow keys) to trace the movable line.

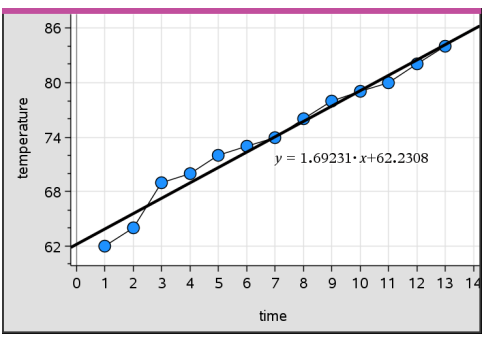
   If the plotted variables change, points on the graph and the line are updated automatically.

Showing a Line of Regression

You can show a line of regression when you have a scatter plot or an X-Y line plot on the work area. Studying the line of regression can help you understand the relationship between two variables.

1. With a scatter plot or X-Y line plot of two variables on the work area, click the **Analyze** menu, choose **Regression** and view the list of regressions.

2. Click the type of regression line to show. For example, choose **Show Linear (mx+b)** to plot a linear regression line as shown in the following example.



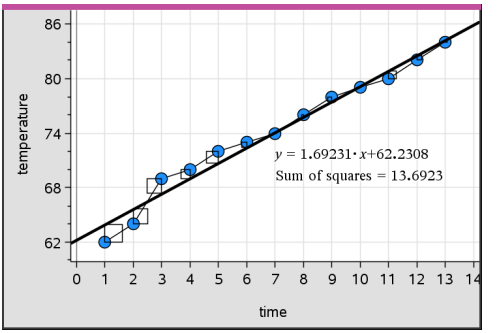
   When the line of regression is selected, the expression for the line displays.

Showing Residual Squares

You can display residual squares on a plot. Residual squares can help you assess the appropriateness of the model for your data.

Note: This tool is only available when a regression or movable line is present in the work area.

▶ From the **Analyze** menu, click **Residuals** > **Show Residual Squares**.

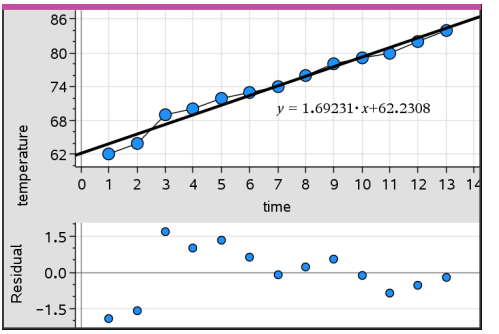


The sum of squares is updated as the line or data changes.

Showing a Residual Plot

You can show a residual plot to determine how well a line fits data. The work area must include a scatter plot and one or more movable lines, regressions, or plotted functions for **Show Residual Plot** to be available.

▶ With a scatter plot, line of regression, and/or movable line in the work area, click the **Analyze** menu, and click **Show Residual Plot > Residuals**.



Notes:

- With multiple regressions or functions and movable lines plotted, you can select each by clicking the line to show its residual plot.
- Click and hold a dot on the residual plot to see the residual.
- The residual plot for the selected regression or function displays in the work area.
- For consistency in comparing sets of data, residual plots do not rescale when you move from one function or regression to another.
- Select a function or regression before a showing residual plot. If no function or regression is selected and there are several plotted, Data & Statistics arbitrarily selects the function or regression for showing the residual plot.
- Axes can be adjusted by clicking and dragging.

Removing a Residual Plot

▶ With a scatter plot, line of regression, and/or movable line in the work area, click the **Analyze** menu, and click **Hide Residual Plot**.

Using Window/Zoom Tools

Use the Window/Zoom tools to redefine the graph to better view points of interest. The Window/Zoom tools include:

- Window Settings: displays a Window Settings dialog box that lets you type the x-min, x-max, y-min, and y-max values for the axes.
- Zoom - Data: adjusts the zoom factor to display all plotted data.
- Zoom - In: lets you define the center point of the zoom in location. The Zoom In factor is approximately 2.
- Zoom - Out: lets you define the center point of the zoom out location. The Zoom Out factor is approximately 2.

Using the Window Settings Tool

1. On the **Window/Zoom** menu, click **Window Settings**.

   The **Window Settings** dialog box opens. The current values for x-min, x-max, y-min, and y-max are displayed in the fields.

   Note: Only the appropriate boxes are editable, depending on whether there are one or two axes in the work area.

2. Type the new values over the old values.
3. Click **OK** to apply the changes and redraw the plot.

Using the Zoom Data Tool

▶ On the **Window/Zoom** menu, click **Zoom Data**.

The work area rescales to display all plotted data.

Using the Zoom In Tool

1. On the **Window/Zoom** menu, click **Zoom In**.
2. In the work area, click the center point of the area of interest. This will be the center of the zoom in action.

   The plot redraws to focus and enlarge the portion of the plot centered about the point you selected in the previous step.

Using the Zoom Out Tool

1. On the **Window/Zoom** menu, click **Zoom Out**.
2. In the work area, click the center point of the area of interest. This will be the center of the zoom out action.

   The plot redraws to display a larger portion of the plot, centered about the point you selected in the previous step.

Graphing Functions

You can graph functions by typing them in Data & Statistics, or you can graph functions defined in other applications.

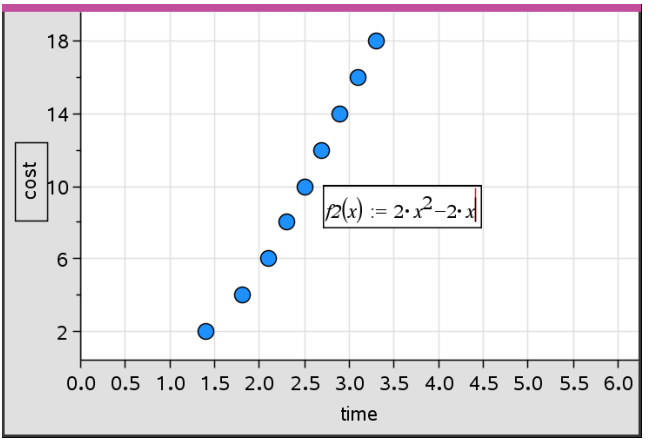
Graphing Functions Using the Plot Function Tool

You can use the Plot Function tool to plot functions in a work area that already includes a plot on the axes. Plot Function lets you specify and graph a function for comparison to an existing plot.

To use the Plot Function tool:

1. Create or open a problem that includes variables (from Lists & Spreadsheet) that are plotted on a Data & Statistics work area. Ensure that your work area contains both a horizontal axis and a vertical axis scale.
2. From the **Analyze** menu, click **Plot Function**.

   A function entry field displays in the work area.

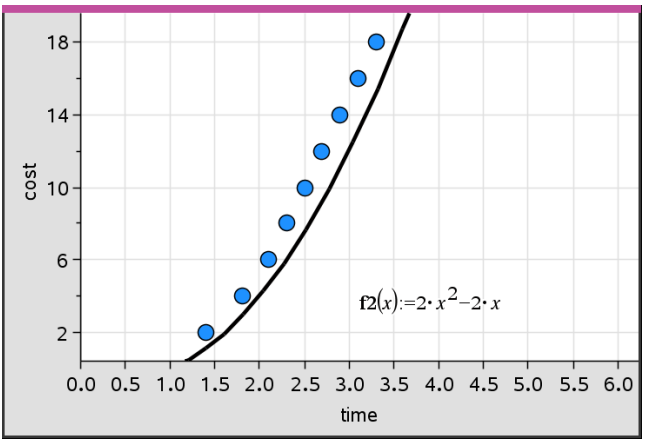


Note: You can edit the function's expression typed in the entry field. However, the function graphed in Data & Statistics cannot be manipulated or moved around the work area. To do that, use Graphs & Geometry.

3. Type the function in the entry field, and press **Enter**.

   Note: You can rename the function by typing over f1(x): with another name, if you choose.

   The function graphs in the work area and is saved as a variable for use in other applications.



Entering Functions from Other Applications

You can enter a function that has been defined as a variable in another application, such as Lists & Spreadsheet, Graphs & Geometry, or Calculator.

1. Add a variable to each axis. You can access any variables defined in a Lists & Spreadsheet or Calculator application in your problem from the variable list.
2. From the **Analyze** menu, click **Plot Function**.

   A function entry field displays in the work area.

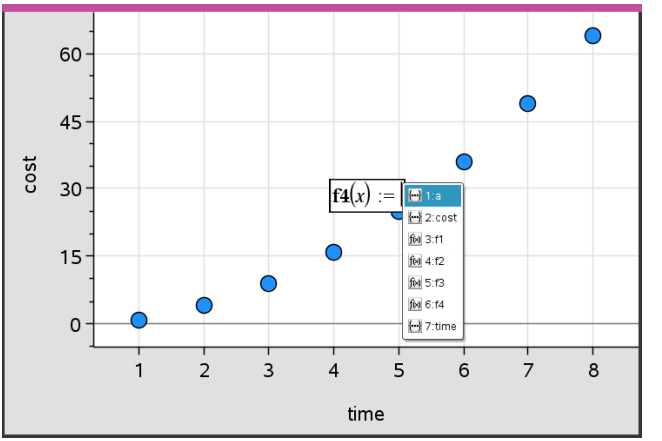
   $f1(x) :=$

3. Click var on the toolbar.

   Handheld: Press var.

   A list of variables available in the problem displays.

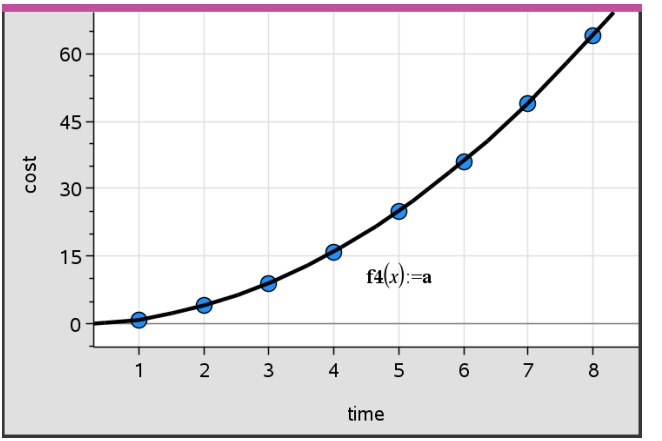
4. Click to select the variable containing the function you want to plot.



   In the example below, the variable a contains the function **f(x)=x^2**.

5. Press **Enter**.

   The function plots in the work area.



Editing a Function

You can edit a function and update it in the work area.

1. You can edit a function by double-clicking the equation and then making changes as required.
2. Press **Enter** after making all changes and the updates are displayed in the work area.

Using Data & Statistics Functions in other Applications

Data & Statistics functions are stored as variables, and may be used in other applications, in the same manner as any other variable. Support for all function types is included.

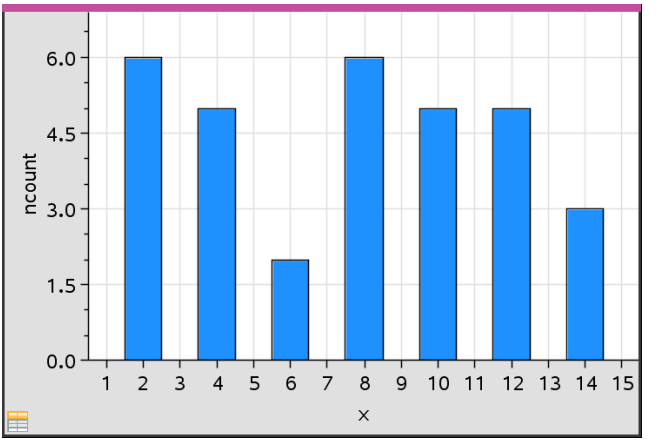
Note: Function numbers increment to use the next available. If you have defined f1(x) and f2(x) in Graphs & Geometry, the first function you create in Data & Statistics will be f3(x).

Using Show Normal PDF

You can approximate data plotted in the Data & Statistics work area against the normal probability density function. The tool overlays the normal probability density function using the mean and the standard deviation of the data in the histogram.

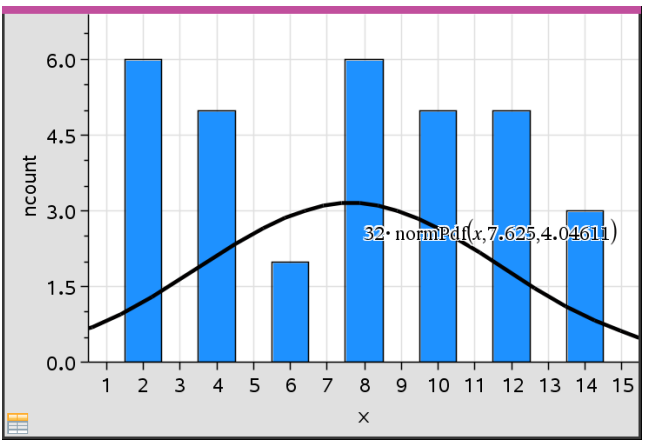
To show the normal probability density function for plotted data:

1. Add a variable to the x-axis.
2. On the **Plot Types** menu, click **Histogram**.



Note:Show Normal PDF is available only when histogram is the plot type.

3. From the **Analyze** menu, click **Show Normal PDF**.



The normal PDF for the graph plots in the work area. The expression used to calculate the PDF displays when selected.

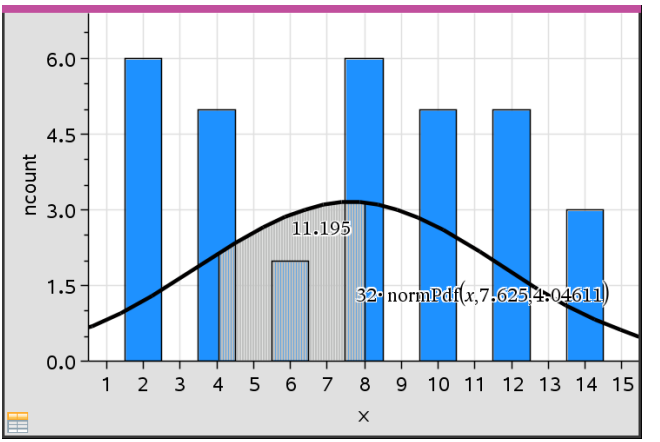
You can click **Hide Normal PDF** on the **Analyze** menu to remove the PDF.

Using Shade Under Function

Use Shade Under Function to find the area of a selected region under a function graphed in the work area.

1. Select any function graphed in the Data & Statistics work area. For example, select a previously graphed normal PDF.
2. From the **Analyze** menu, click **Shade Under Function**.

   The pointer becomes a dotted vertical line and the boundary +/- ∞ displays when you position the mouse near the boundary on the left or right. You can click when ∞ displays to set it as a boundary.



3. Select a point on the curve and click to indicate where to start shading under the function. The direction in which you move next determines whether the region shaded is on the left, right, or center of the curve.
4. Select a point on the curve and click to indicate the end boundary of the shaded area. A region under the function is shaded based on the points you selected.

   You can work with Shade Under Function in the following ways:

   - Select the region to display the values for data points in the shaded area.
   - To remove the shading, right-click or **Ctrl**-click the shaded region and choose **Remove Shaded Region**.
   - To change the fill color of the shaded area, right-click or **Ctrl**-click the shaded region, choose **Color,** choose **Fill**, and click a color.
   - Use plot value to set the boundary to an exact number. When a boundary for shading is set to a plotted value, you can change the plotted value to update the shading.
   - Edit a shaded region by clicking and dragging the edge at the starting or ending boundary.

Using Graph Trace

Graph Trace lets you move from one point on a graph to another to analyze variations in the data. You can use Graph Trace mode to explore the data for the following graphs.

- Graphs from Plot Function and Show Normal PDF
- Distribution curves (created in the Lists & Spreadsheet application)
- Movable Lines
- Regressions
- Caseplots
- Dot plots
- Scatter plots and X-Y line plots
- Box plots
- Histograms
- Bar charts
- Pie charts

To use Graph Trace

1. From the **Analyze** menu, click **Graph Trace**.
2. Press ◄ or ► to move across the plot.

   The data representations enlarge and appear with a bold outline as you move across them in Trace mode.

Customizing Your Workspace

Working with Color

All data points for a plotted variable display in the same color to distinguish them from the data points of other variables. Data plotted by category and split plots are automatically displayed in different colors to help you distinguish the data.

To emphasize or distinguish certain parts of your work, you can change the default color for a variable's data.

- Apply fill colors to objects, such as shading, or change the color for a variable's data points.
- Apply color to plotted lines (such as lines of regression) or movable lines.

Inserting a Background Image

When using the computer software, you can insert an image as a background for a Data & Statistics page. The file format of the image can be .bmp, .jpg, or .png.

1. From the **Insert** menu, click **Image**.
2. Navigate to the image that you want to insert.
3. Select it, and then click **Open**.

   The image is inserted as a background.

For more information, see the *Working with Images* chapter.

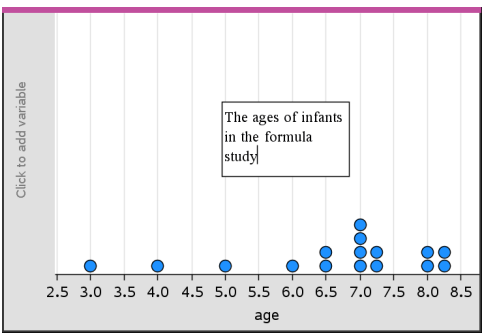
Working with Text

The Insert Text tool lets you type text to describe details related to plots on the work area.

1. From the **Actions** menu, click **Insert Text**.

   A text box opens.

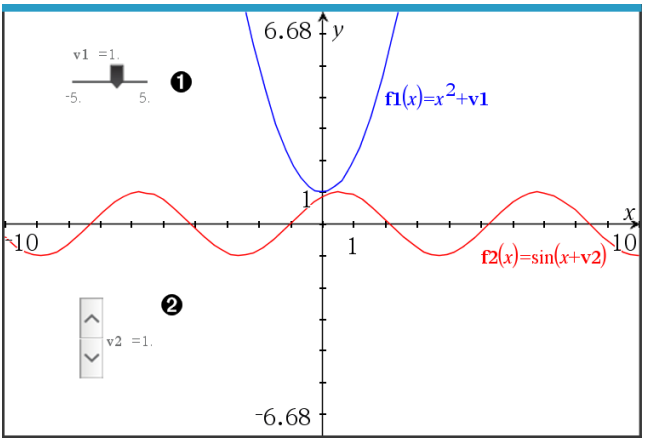
2. Type notes or descriptions in the text box.



3. Customize the text to suit your needs.
   - Move the pointer over the edges of the text box to drag the borders and change the width or height.
   - Click and grab the text box to move it near objects that relate to the text.
   - Scroll to view additional text in a box by clicking the arrows at the top and bottom edge.
   - Click outside of the text entry box to exit the Text tool.
   - Hide text by clicking the **Actions** menu and clicking **Hide Text**.
   - Change the color of text.

Adjusting Variable Values with a Slider

A slider control lets you interactively adjust or animate the value of a numeric variable. You can insert sliders in the Graphs, Geometry, Notes, and Data & Statistics applications.



❶ Horizontal slider for adjusting variable *v1*.

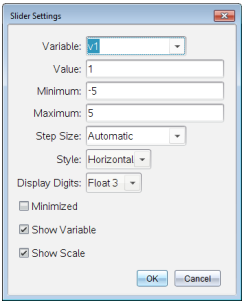
❷ Minimized vertical slider for adjusting variable *v2*.

Note: TI-Nspire™ version 4.2 or higher is required for opening .tns files containing sliders on Notes pages.

Inserting a Slider Manually

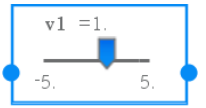
1. From a Graphs, Geometry, or Data & Statistics page, select **Actions > Insert Slider**.
   —or—
   From a Notes page, make sure the cursor is not in a math box or chem box, and then select **Insert > Insert Slider**.

   The Slider Settings screen opens.



2. Enter the desired values, and click **OK**.

The slider is displayed. On a Graphs, Geometry, or Data & Statistics page, handles are displayed to let you move or stretch the slider.



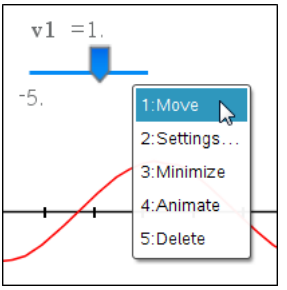
To remove the handles and use the slider, click an empty space in the work area. You can show the handles anytime by selecting **Move** from the slider's context menu.

3. To adjust the variable, slide the pointer (or click the arrows on a minimized slider).
   - You can use the **Tab** key to move the focus to a slider or to move from one slider to the next. The color of the slider changes to show you when it has the focus.
   - When a slider has the focus, you can use the arrow keys to change the value of the variable.

Working with the Slider

Use the options on the context menu to move or delete the slider, and to start or stop its animation. You can also change the slider's settings.

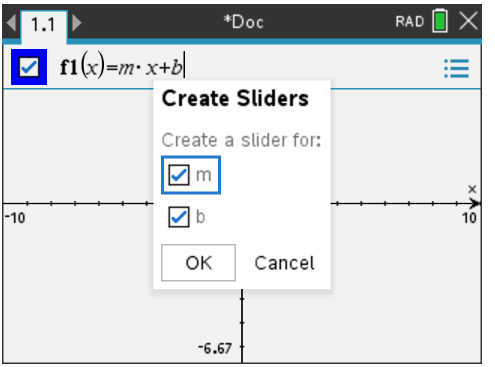
1. Display the slider's context menu.



2. Click an option to select it.

Automatic Sliders in Graphs

Sliders can be created for you automatically in the Graphs application and in the analytic window of the Geometry application. You are offered automatic sliders when you define certain functions, equations, or sequences that refer to undefined variables.



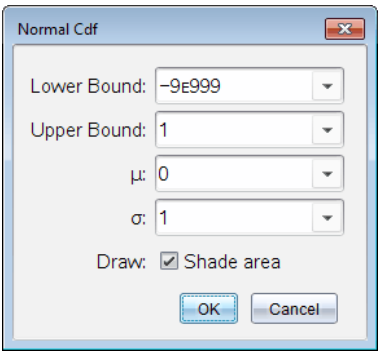
Inferential Statistics

You can explore hypothesis tests and probability distributions in the Data & Statistics application after entering the data on a Lists & Spreadsheet page.

Drawing Inferential Statistics Plots

The following example uses the Draw option of the **normCdf()** function to plot a distribution model.

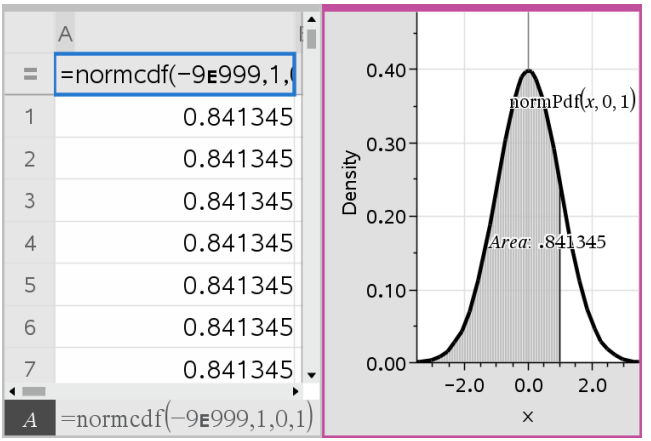
1. On a Lists & Spreadsheet page, select the column-formula cell (second cell from the top) in column A.
2. From the **Statistics menu**, click **Distributions**, and click **Normal Cdf**.



3. Type the plot parameters into the **Normal Cdf** wizard.
4. Select the **Draw** check box to see the distribution plotted and shaded in Data & Statistics.

   Note: The Draw option is not available for all distributions.

5. Click **OK**.

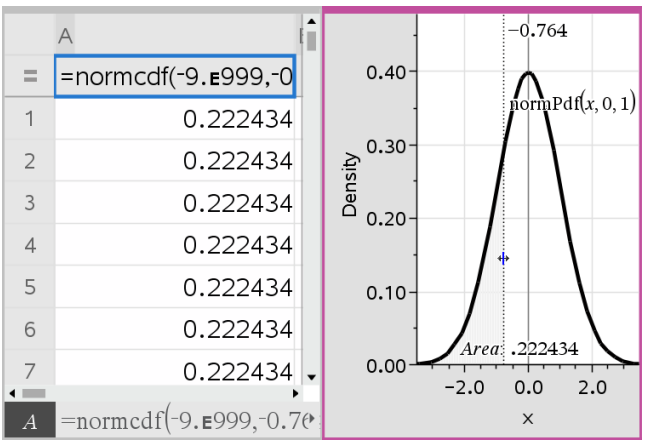


Exploring Inferential Statistics Plots

After drawing the plot in the previous example, you can explore the effect of changing the upper bound.

▶ On the Data & Statistics plot, drag the vertical line that represents the upper bound toward the left or right.

As you drag, the formula is updated and the shaded area is recalculated.



Geometry Application

The Geometry application lets you:

- Create and explore geometric objects and constructions.
- Manipulate and measure geometric objects.
- Animate points on objects and explore their behavior.
- Explore object transformations.

Adding a Geometry Page

▶ To start a new document with a blank Geometry page:

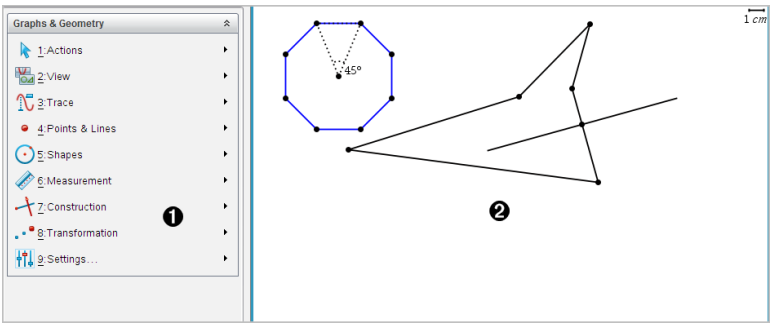
From the main **File** menu, click **New Document**, and then click **Add Geometry**.

Handheld: Press [on], and select **Geometry**.

▶ To add a Geometry page in the current problem of an existing document:

From the toolbar, click **Insert > Geometry**.

Handheld: Press [doc] and select **Insert > Geometry**.



❶ Geometry menu – Available anytime you are viewing a Geometry page.

❷ Geometry work area -- The drawing area where you create and explore geometric objects.

What You Must Know

Changing the Graphs and Geometry Settings

1. From the **Settings** menu in the Documents Toolbox, select **Settings**.
2. Select the settings that you want to use.
   - **Display Digits.** Sets the display format for numbers as Floating or Fixed decimal.

- **Graphing Angle.** Sets the angle unit for all Graphs and 3D Graphing applications in the current docuument. The default setting is Radian. Set this to Auto if you want graphing angles to follow the Angle setting in the main **File > Settings** menu. An angle mode indicator shows the resulting mode in Graphs and 3D Graphing applications.
- **Geometry Angle.** Sets the angle unit for all Geometry applications in the current document. The default setting is Degree. Set this to Auto if you want geometry angles to follow the Angle setting in the main **File > Settings** menu. An angle mode indicator shows the resulting mode in Geometry applications.
- **Grid.** Sets the grid display in the Graphs application. The default setting is No Grid. Dot Grid and Lined Grid are also available.
- **Automatically hide plot labels.** In the Graphs application, hides the label that normally appears next to a graphed relation.
- **Show axis end values.** Applies only in the Graphs application.
- **Show tool tips for function manipulation.** Applies only in the Graphs application.
- **Automatically find points of interest.** In the Graphs application, shows zeros, minima, and maxima while tracing function graphs.
- **Force Geometric Triangle Angles to Integers.** Restricts the angles of a triangle to integer values as you create or edit the triangle. This setting applies only in the Geometry View with the Geometry Angle unit set to Degree or Gradian. It does not apply to analytic triangles in Graphing View or to analytic triangles in the Analytic Window of the Geometry View. This setting does not affect existing angles, and it does not apply when constructing a triangle based on previously inserted points. By default, this setting is deselected.
- **Automatically Label Points.** Applies labels (A, B, ..., Z, A_1, B_1, and so on) to points, lines, and vertices of geometric shapes as you draw them. The labeling sequence starts at A for each page in a document. By default, this setting is deselected.

  Note: If you create a new object that uses existing unlabeled points, those point are not automatically labeled in the completed object.
- Click **Restore** to restore all settings to their factory defaults.
- Click **Make Default** to apply the current settings to the open document and save them as the default for new Graphs and Geometry documents.

Using Context Menus

Context menus provide quick access to commonly used commands and tools that apply to a specific object. For example, you can use a context menu to change an object's line color or to group a set of selected objects.

▶ Display the context menu for an object in one of the following ways.

- Windows®: Right-click the object.
- Mac®: Hold ⌘ and click the object.
- Handheld: Move the pointer to the object, and then press ctrl menu.

Finding Hidden Objects in the Graphs or Geometry Application

You can hide and show individual graphs, geometric objects, text, labels, measurements, and axis end-values.

To temporarily view hidden graphs or objects or to restore them as shown objects:

1. From the **Actions** menu, select **Hide/Show**.

   The Hide/Show tool appears in the work area, and all hidden objects become visible in dimmed colors.

2. Click a graph or object to toggle its Hide/Show state.
3. To apply the changes and close the Hide/Show tool, press **ESC**.

Inserting a Background Image

You can insert an image as a background for a Graphs or Geometry page. The file format of the image can be .bmp, .jpg, or .png.

1. From the **Insert** menu, click **Image**.
2. Navigate to the image you want to insert, select it, and then click **Open**.

For information on moving, resizing, and deleting a background image, see *Working with Images in the Software*.

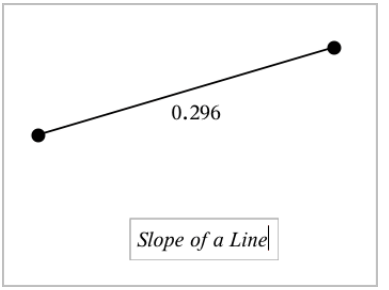
Adding Text to the Graphs or Geometry Work Area

1. From the **Actions** menu, select **Text**.

   The Text tool appears in the work area.

2. Click the location for the text.

3. Type the text in the box that appears, and then press **Enter**.



4. To close the Text tool, press **ESC**.
5. To edit the text, double-click it.

Deleting a Relation and its Graph

1. Select the relation by clicking its graph.
2. Press **Backspace** or **DEL**.

   The graph is removed from both the work area and the graph history.

Introduction to Geometric Objects

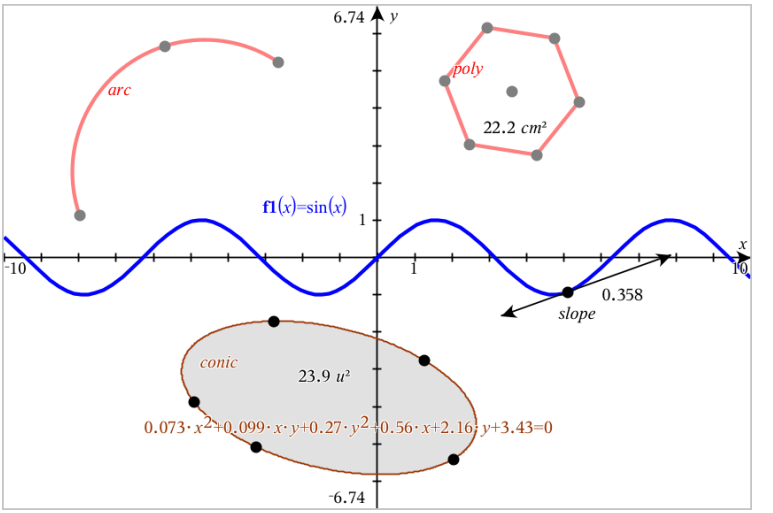
Geometry tools are accessible in both the Graphs and Geometry applications. You can use these tools to draw and investigate objects such as points, lines, and shapes.

- The Graphing view shows the Graphs work area superimposed on the Geometry work area. You can select, measure, and alter objects in both work areas.
- The Plane Geometry view shows only the objects created in the Geometry application.

Objects Created in the Graphs Application

Points, lines, and shapes created in the Graphs application are analytic objects.

- All points that define these objects reside on the x,y graph plane. Objects created here are visible only in the Graphs application. Changing the axes scale affects the appearance of the objects.
- You can display and edit the coordinates of any point on an object.
- You can display the equation of a line, tangent line, circle shape, or geometric conic created in the Graphs application.

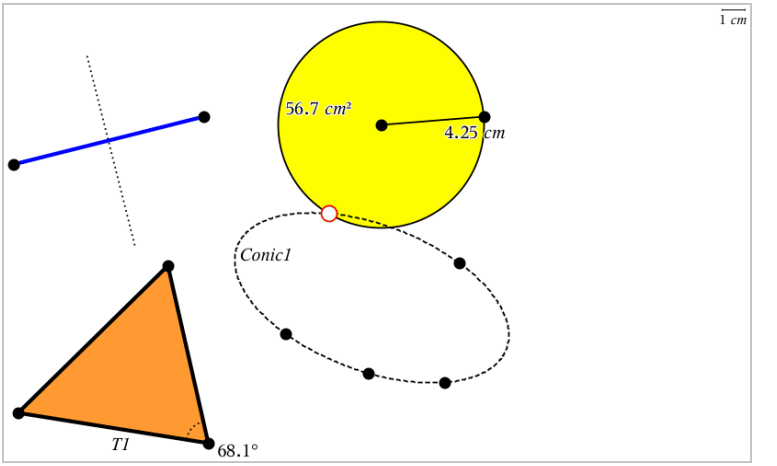


The circle arc and polygon were created in the Geometry application. The sine wave and conic were created in the Graphs application.

Objects Created in the Geometry Application

Points, lines, and shapes created in the Geometry application are not analytic objects.

- Points that define these objects do not reside on the graph plane. Objects created here are visible in both the Graphs and Geometry applications, but they are unaffected by changes to the Graphs x,y axes.
- You cannot obtain the coordinates of an object's points.
- You cannot display the equation of a geometric object created in the Geometry application



Creating Points and Lines

As you create an object, a tool appears in the work area (for example, **Segment**). To cancel, press **ESC**. To enable automatic labeling of certain objects, see *What You Must Know* in this chapter.

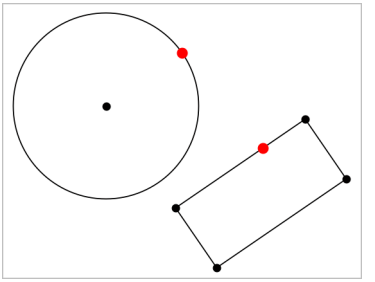
Creating a Point on the Work Area

1. From the **Points and Lines** menu, select **Point**. (In the Graphs application, click **Geometry > Points and Lines > Point**.)
2. Click a location to create the point.
3. (Optional) Label the point.
4. To move a point, drag it.

Creating a Point on a Graph or Object

You can create a point on a line, segment, ray, axis, vector, circle, graph, or axis.

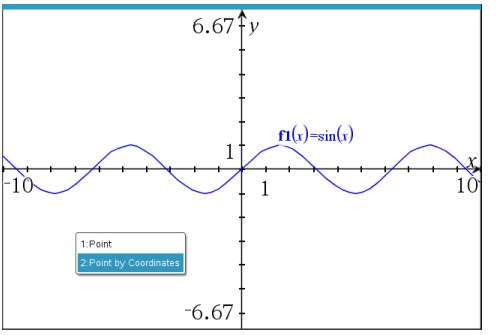
1. From the **Points and Lines** menu, select **Point On**. (In the Graphs application, click **Geometry > Points and Lines > Point On**.)
2. Click the graph or object on which you want to create the point.
3. Click a location on the object to place the point.



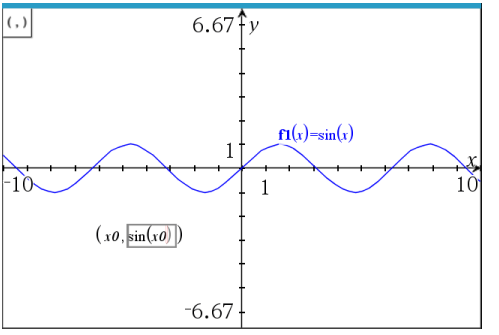
Creating a Dynamic Point on a Graph

You can create a dynamic point on a graph with Point by Coordinates.

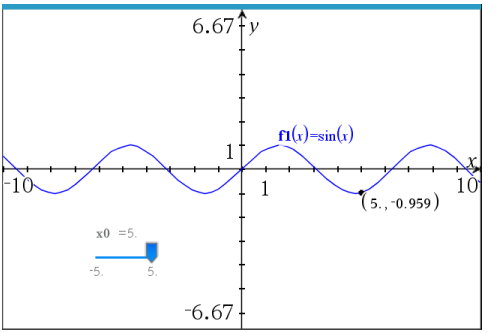
1. From the **Points and Lines** menu, select **Point by Coordinates**. (In the Graphs application, click **Geometry > Points and Lines > Point by Coordinates** or press **P** and select **Point by Coordinates**).



2. Enter the variables or expressions for one or both of the coordinates.



3. Use the slider that is created to move the point on the graph.

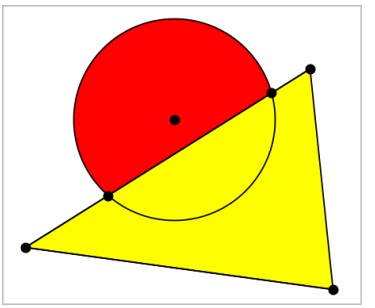


The point will display the actual coordinates. If you hover the cursor over a coordinate, it will display the variable or expression.

To edit the point, double-click the coordinate on the label. Any variable or expression that was entered before is retained.

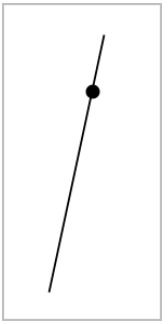
Identifying Points of Intersection

1. From the **Points and Lines** menu, select **Intersection Points**. (In the Graphs application, click **Geometry > Points and Lines > Intersection Points**.)
2. Click two intersecting objects to add points at their intersections.



Creating a Line

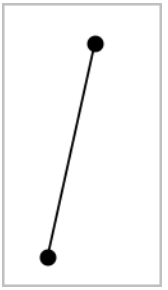
1. From the **Points and Lines** menu, select **Line**. (In the Graphs application, click **Geometry > Points and Lines > Line**.)
2. Click a location to define one point on the line.
3. Click a second location to define the direction of the line and the length of its visible portion.



4. To move a line, drag its identifying point. To rotate it, drag any point except the identifying point or ends. To extend its visible portion, drag from either end.

Creating a Segment

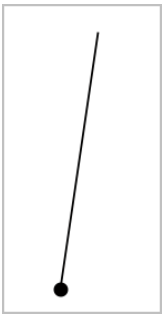
1. From the **Points and Lines** menu, select **Segment**. (In the Graphs application, click **Geometry > Points and Lines > Segment**.)
2. Click two locations to define the endpoints of the segment.



3. To move a segment, drag any point other than an endpoint. To manipulate the direction or length, drag either endpoint.

Creating a Ray

1. From the **Points and Lines** menu, select **Ray**. (In the Graphs application, click **Geometry > Points and Lines > Ray**.)
2. Click a location to define the endpoint of the ray.
3. Click a second location to define the direction.

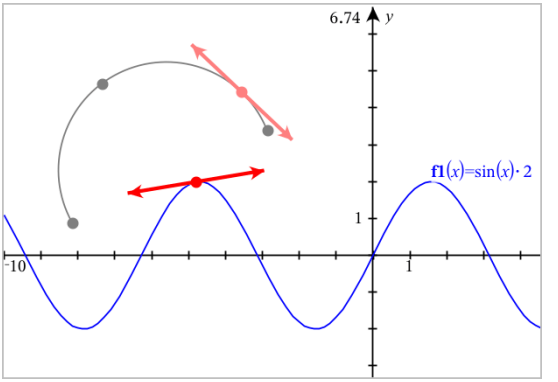


To move a ray, drag its identifying point. To rotate it, drag any point except the identifying point or end. To extend its visible portion, drag from the end.

Creating a Tangent

You can create a tangent line at a specific point on a geometric object or function graph.

1. From the **Points and Lines** menu, select **Tangent**. (In the Graphs application, click **Geometry > Points and Lines > Tangent**.)
2. Click the object to select it.
3. Click a location on the object to create the tangent.

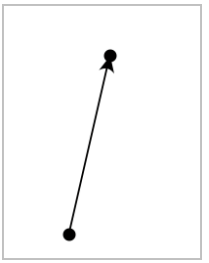


4. To move a tangent, drag it. It remains attached to the object or graph.

Creating a Vector

1. From the **Points and Lines** menu, select **Vector**. (In the Graphs application, click **Geometry > Points and Lines > Vector**.)

2. Click a location to establish the vector's initial point.
3. Click a second location to specify direction and magnitude and complete the vector.

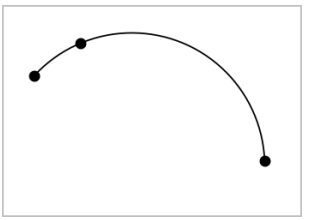


4. To move a vector, drag any point other than the endpoints. To manipulate the magnitude and/or direction, drag either end point.

   Note: If you create an endpoint on an axis or another object, you can move the endpoint only along that object.

Creating a Circle Arc

1. From the **Points and Lines** menu, select **Circle Arc**. (In the Graphs application, click **Geometry > Points and Lines > Circle Arc**.)
2. Click a location or point to establish the starting point of the arc.
3. Click a second point to establish an intermediate point through which the arc will pass.
4. Click a third point to set the ending point and complete the arc.



5. To move an arc, drag its perimeter. To manipulate it, drag any of its three defining points.

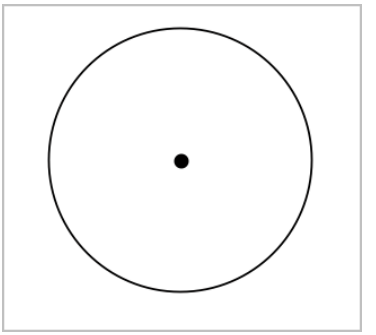
Creating Geometric Shapes

The Shape tools let you explore circles, polygons, conics, and other geometric objects.

As you create a shape, a tool appears in the work area (for example, **Circle**). To cancel the shape, press **ESC**. To enable automatic labeling of certain objects, see *What You Must Know*, in this chapter.

Creating a Circle

1. From the **Shapes** menu, select **Circle**. (In the Graphs application, click **Geometry > Shapes > Circle**.)
2. Click a location or point to position the circle's center point.
3. Click a location or point to establish the radius and complete the circle.

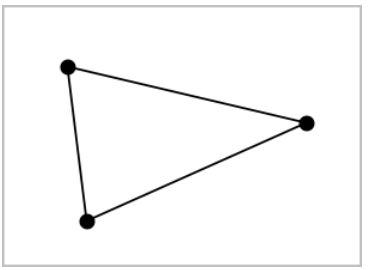


4. To resize a circle, drag its perimeter. To move it, drag its center point.

Creating a Triangle

Note: To ensure that the sum of the angles of a triangle equals 180° or 200 gradians, you can force integer angles in the Geometry view. Refer to *What You Must Know*, in this chapter.

1. From the **Shapes** menu, select **Triangle**. (In the Graphs application, click **Geometry > Shapes > Triangle**.)
2. Click three locations to establish the vertices of the triangle.

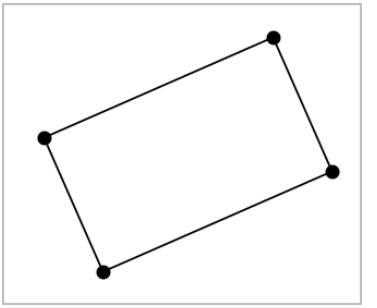


3. To manipulate a triangle, drag any point. To move it, drag any side.

Creating a Rectangle

1. From the **Shapes** menu, select **Rectangle**. (In the Graphs application, click **Geometry > Shapes > Rectangle**.)
2. Click a location or point to establish the first corner of the rectangle.
3. Click a location for the second corner.

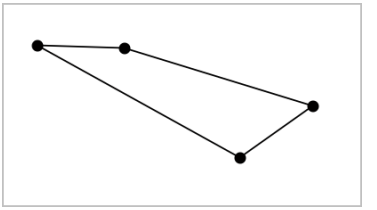
   One side of the rectangle is displayed.
4. Click to establish the distance to the opposite side and complete the rectangle.



5. To rotate a rectangle, drag one of its first two points. To extend it, drag one of the last two points. To move it, drag any side.

Creating a Polygon

1. From the **Shapes** menu, select **Polygon**. (In the Graphs application, click **Geometry > Shapes > Polygon**.)
2. Click a location or point to establish the first vertex of the polygon.
3. Click to establish each additional vertex.
4. To complete the polygon, click the first vertex.

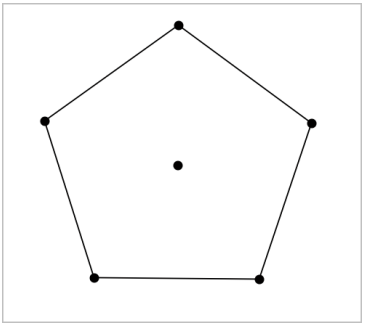


5. To manipulate a polygon, drag any vertex. To move it, drag any side.

Creating a Regular Polygon

1. From the **Shapes** menu, select **Regular Polygon**. (In the Graphs application, click **Geometry > Shapes > Regular Polygon**.)
2. Click once on the work area to establish the center point.
3. Click a second location to establish the first vertex and radius.

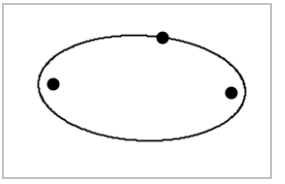
   A 16-sided regular polygon is formed. The number of sides is displayed in brackets; for example, {16}.
4. Drag any vertex in a circular motion to set the number of sides.
   - Drag clockwise to reduce the number of sides.
   - Drag counterclockwise to add diagonals.



5. To resize or rotate a regular polygon, drag any of its points. To move it, drag any side.

Creating an Ellipse

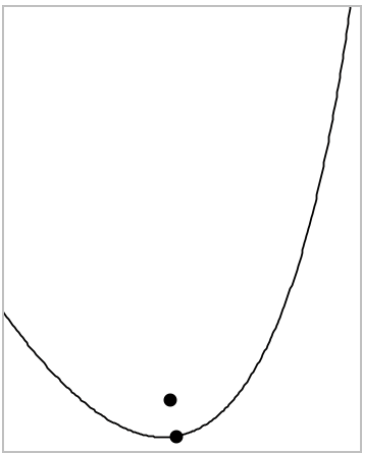
1. From the **Shapes** menu, select **Ellipse**. (In the Graphs application, click **Geometry > Shapes > Ellipse**.)
2. Click two locations or points to establish the foci.
3. Click to establish a point on the ellipse and complete the shape.



4. To manipulate an ellipse, drag any of its three defining points. To move it, drag its perimeter.

Creating a Parabola (from focus and vertex)

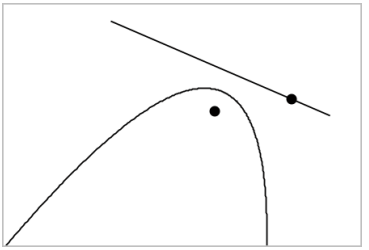
1. From the **Shapes** menu, select **Parabola**. (In the Graphs application, click **Geometry > Shapes > Parabola**.)
2. Click a location to establish the focus.
3. Click a location to establish the vertex and complete the parabola.



4. To manipulate a parabola, drag its focus or its vertex. To move it, drag it from any other point.

Creating a Parabola (from focus and directrix)

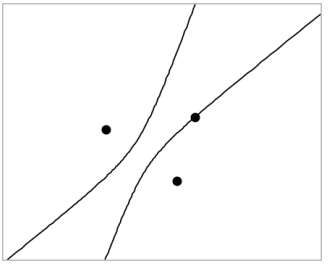
1. Create a line to serve as the directrix.
2. From the **Shapes** menu, select **Parabola**. (In the Graphs application, click **Geometry > Shapes > Parabola**.)
3. Click a location to establish the focus.
4. Click the line to establish it as the directrix.



5. To manipulate a parabola, rotate or move its directrix or drag its focus. To move it, select both the directrix and the focus, and then drag either object.

Creating a Hyperbola

1. From the **Shapes** menu, select **Hyperbola**. (In the Graphs application, click **Geometry > Shapes > Hyperbola**.)
2. Click two locations to establish the foci.
3. Click a third location to complete the hyperbola.

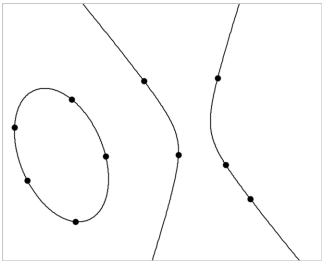


4. To manipulate a hyperbola, drag any of its three defining points. To move it, drag it from any other place on the shape.

Creating a Conic by Five Points

1. From the **Shapes** menu, select **Conic by Five Points**. (In the Graphs application, click **Geometry > Shapes > Conic by Five Points**.)
2. Click five locations to establish the five points on the shape.

   Depending on the pattern of the points, the conic can be a hyperbola or an ellipse.



3. To manipulate a conic, drag any of its five defining points. To move it, drag it from any other place on the shape.

Creating Shapes Using Gestures (MathDraw)

The MathDraw tool lets you use touchscreen or mouse gestures to create points, lines, circles, and other shapes.

MathDraw is available in:

- Geometry view without the analytic window displayed.
- Graphing view when the x scale and y scale are identical. This avoids non-circular ellipses and non-square rectangles appearing as circles and squares.

MathDraw is not available in the 3D Graphing view or in the Geometry view with the analytic window displayed.

Activating MathDraw

1. If using the Geometry view with the analytic window visible, use the **View** menu to hide the window.
2. On the **Actions** menu, select **MathDraw**.

   The MathDraw icon appears. You can begin using the tool.

Canceling MathDraw

▶ When you have finished using the MathDraw tool, press **Esc**.

The tool also closes if you select a different tool or change views.

Creating Points

To create a labeled point, tap or click in an open area.

- If the point is close to an existing line, segment, ray, geometric conic (including circles), or polygon, the point snaps to that object. You can also place a point on the intersection of any two of those types of objects.

- If the point is close to a visible grid location in a Graphs view or the analytic window of a Geometry view, it snaps to the grid.

Drawing Lines and Segments

To create a line or segment, touch or click the initial position, and then drag to the end position.

- If the drawn line passes near an existing point, the line snaps to the point.
- If the drawn line starts close to an existing point and ends next to another existing point , it becomes a segment defined by those points.
- If the drawn line is nearly parallel or perpendicular to an existing line, segment, or side of a polygon, it aligns to that object.

  Note: The default tolerance for detecting parallel/perpendicular lines is 12.5 degrees. This tolerance can be redefined using a variable named **ti_gg_fd.angle_tol**. You can change the tolerance in the current problem by setting this variable in the calculator app to a value in the range 0 through 45 (0=no parallel/perpendicular detection).

Drawing Circles and Ellipses

To create a circle or ellipse, use the touchscreen or mouse to draw the approximate shape.

- If the drawn shape is sufficiently circular, a circle is created.
- If the shape is elongated, an ellipse is created.
- If the virtual center of the drawn shape is near an existing point, the circle or ellipse is centered on that point.

Drawing Triangles

To create a triangle, draw a triangle-like shape.

- If a drawn vertex is close to an existing point, the vertex snaps to the point.

Drawing Rectangles and Squares

To create a rectangle or square, use the touchscreen or mouse to draw the perimeter.

- If the drawn shape is nearly square, a square is created.
- If the drawn shape is elongated, a rectangle is created.
- If the center of a square is close to an existing point, the square snaps to that point.

Drawing Polygons

To create a polygon, tap or click a succession of existing points, ending on the first point you tapped.

Using MathDraw to Create Equations

In the Graphs view, MathDraw attempts to recognize certain gestures as functions for analytic parabolas.

Note: The default step value for quantization of the parabola coefficients is 1/32. The denominator of this fraction can be redefined using a variable named **ti_gg_fd.par_quant**. You can change the step value in the current problem by setting this variable to a value greater or equal to 2. A value of 2, for example, produces a step value of 0.5.

Using MathDraw to Measure an Angle

To measure the angle between two existing lines, use the touchscreen or mouse to draw a circle arc from one of the lines to the other.

- If the intersection point between the two lines does not exist, it is created and labeled.
- The angle is not a directed angle.

Using MathDraw to Find a Mid-point

To create a point midway between two points, tap or click point 1, point 2, and then point 1 again.

Using MathDraw to Erase

To erase objects, use the touchscreen or mouse to drag left and right, similar to the motion of erasing a whiteboard.

- The erasure area is the bounding rectangle of the erasure gesture.
- All point objects and their dependents inside the erasure area are removed.

Basics of Working with Objects

Selecting and Deselecting Objects

You can select an individual object or multiple objects. Select multiple objects when you want to quickly move, color, or delete them together.

1. Click an object or graph to select it.

The object flashes to indicate selection.

2. Click any additional objects to add them to the selection.
3. Perform the operation (such as moving or setting color).
4. To deselect all objects, click an empty space in the work area.

Grouping and Ungrouping Geometric Objects

Grouping objects gives you a way to reselect them as a set, even after you have deselected them to work with other objects.

1. Click each object to add it to the current selection.

   The selected objects flash.

2. Display a context menu of the selected object or objects.
3. Click **Group**. You can now select all the items in the group by clicking any of its members.
4. To split a group into individual objects, display a context menu of any of its member objects, and click **Ungroup**.

Deleting Objects

1. Display the context menu of the object or objects.
2. Click **Delete**.

   You cannot delete the origin, the axes, or points representing locked variables, even if those items are included in the selection.

Moving Objects

You can move an object, group, or combination of selected objects and groups.

Note: If an immovable object (such as the graph axes or a point with locked coordinates) is included in a selection or group, you cannot move any of the objects. You must cancel the selection and then select only movable items.

To move this...	Drag this
A multiple-object selection or group	Any of its objects

To move this...	Drag this
A point	The point
A segment or vector	Any point other than an endpoint
A line or ray	The identifying point
A circle	The center point
Other geometric shapes	Any position on the object except one of its defining points. For example, move a polygon by dragging any of its sides.

Constraining Object Movement

Holding down the **SHIFT** key before dragging lets you constrain how certain objects are drawn, moved, or manipulated.

Use the constraint feature to:

- Rescale only a single axis in the Graphs application.
- Pan the work area horizontally or vertically, depending on which direction you drag initially.
- Limit object movement to horizontal or vertical.
- Limit point placement to 15° increments as you draw a triangle, rectangle, or polygon.
- Limit angle manipulations to 15° increments.
- Limit the radius of a resized circle to integer values.

Pinning Objects

Pinning objects prevents accidental changes as you move or manipulate other objects.

You can pin graphed functions, geometric objects, text objects, the graph axes, and the background.

1. Select the object or objects to pin, or click an empty area if you are pinning the background.
2. Display the context menu, and select **Pin**.

   A pinned object displays a pin icon when you point to it.

3. To unpin an object, display its context menu, and select **Unpin**.

Notes:

- Although you cannot drag a pinned point, you can reposition it by editing its x and y coordinates.
- You cannot pan the work area while the background is pinned.

Changing the Line or Fill Color of an Object

Color changes made in the software are displayed in shades of gray when you work on documents using a TI-Nspire™ CX handheld that does not support color. Color is preserved when you move documents back to the software.

1. Select the object or objects.
2. Display the object's context menu, click **Color**, and then click **Line Color** or **Fill Color**.
3. Select the color to apply to the objects.

Changing the Appearance of an Object

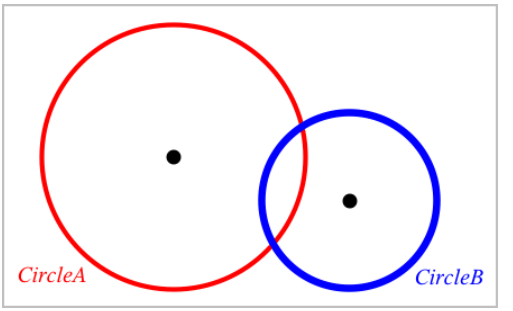
1. From the **Actions** menu, select **Attributes**.
2. Click the object that you want to change. You can change shapes, lines, graphs, or graph axes.

   The list of the attributes for the selected object are displayed.
3. Press ▲ and ▼ to move through the list of attributes.
4. At each attribute icon, press ◄ or ► to move through the options. For example, select Thick, Thin, or Medium for the Line Weight attribute.
5. Press **Enter** to apply the changes.
6. Press **ESC** to close the Attributes tool.

Labeling Points, Geometric Lines, and Shapes

1. Display the context menu of the object.
2. Click **Label**.
3. Type the text of the label, and then press **Enter**.

   The label attaches itself to the object and follows the object as you move it. The label's color matches the object's color.



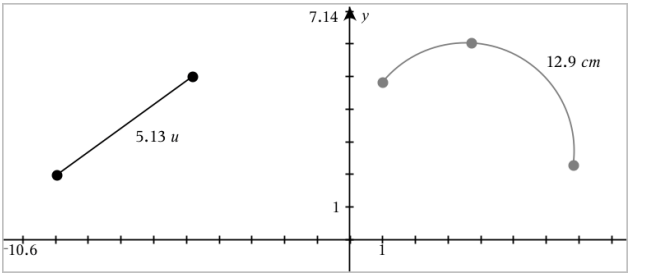
Measuring Objects

Measurement values update automatically as you manipulate the measured object.

Note: Measurements of objects created in the Graphs application are displayed in generic units named *u*. Measurements of objects created in the Geometry application are displayed in centimeters (*cm*).

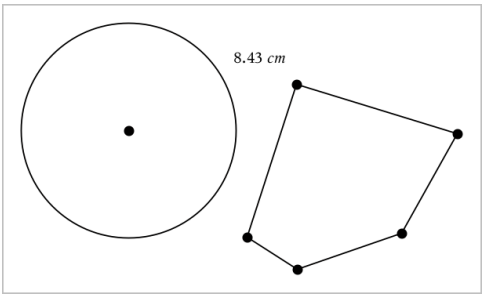
Measuring Length of a Segment, Circle Arc, or Vector

1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click the object to display its length.



Measuring Distance Between Two Points, a Point and a Line, or a Point and a Circle

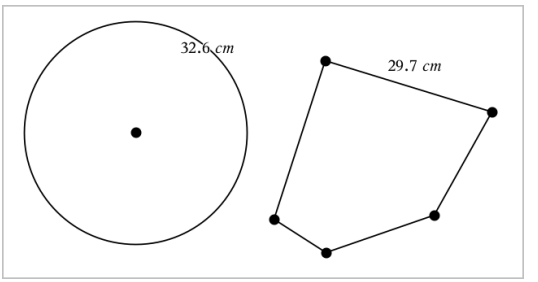
1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click the first point.
3. Click the second point or a point on the line or circle.



In this example, length is measured from the center of the circle to the upper left vertex of the polygon.

Measuring Circumference of a Circle or Ellipse or the Perimeter of a Polygon, Rectangle, or Triangle

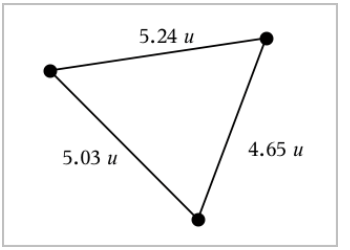
1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click the object to display its circumference or perimeter.



Measuring a Side of a Triangle, Rectangle, or Polygon

1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click two points on the object that form the side you want to measure.

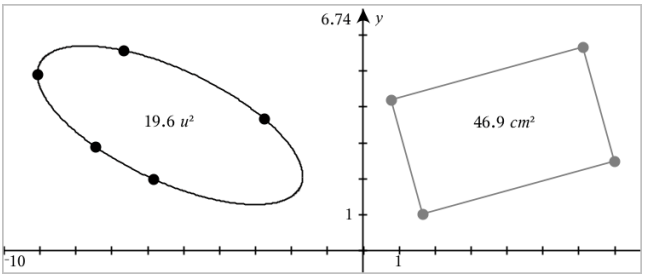
   Note: You must click *two points* to measure a side. Clicking the side measures the entire length of the object's perimeter.



Measuring Area of a Circle, Ellipse, Polygon, Rectangle, or Triangle

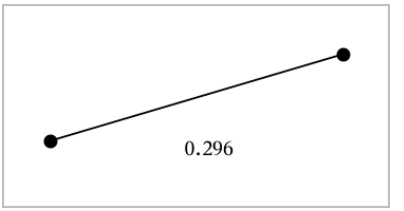
Note: You cannot measure the area of a polygon constructed using the Segment tool.

1. From the **Measurement** menu, select **Area**. (In the Graphs application, click **Geometry > Measurement > Area**.)
2. Click the object to display its area.



Measuring Slope of a Line, Ray, Segment, or Vector

1. From the **Measurement** menu, select **Slope**. (In the Graphs application, click **Geometry > Measurement > Slope**.)
2. Click the object to display its slope.

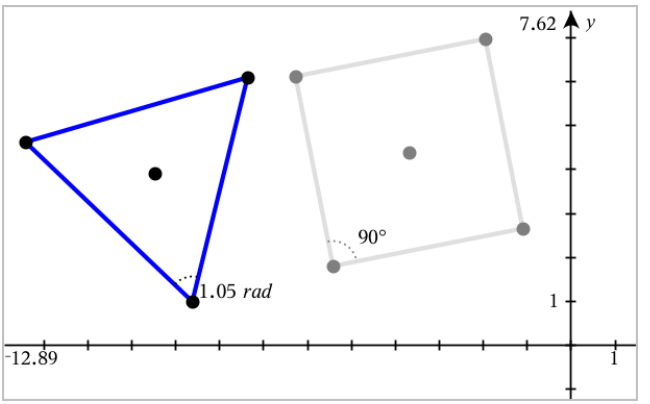


The value is updated automatically when you manipulate the object.

Measuring Angles

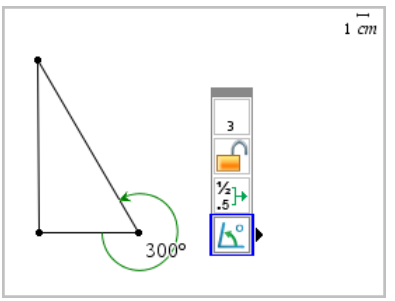
Measured angles in the Geometry application range from 0° to 180°. Measured angles in the Graphs application range from 0 radians to π radians. To change the angle unit, use the **Settings** menu.

1. From the **Measurement** menu, select **Angle**. (In the Graphs application, click **Geometry > Measurement > Angle**.)
2. Click three locations or points to define the angle. The second click defines the vertex.



Measuring Angles using the Directed Angle Tool

1. From the **Measurement** menu, select **Directed Angle**. (In the Graphs application, click **Geometry > Measurement > Directed Angle**.)
2. Click three locations or existing points to define the angle. The second click defines the vertex.



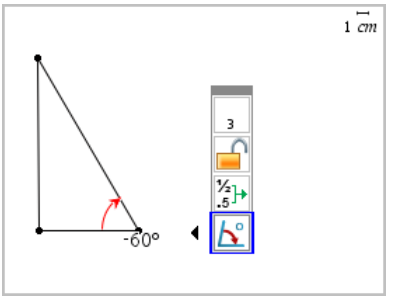
3. To reverse the measurement orientation,

a) On the **Actions** menu, select **Attributes**.

b) Click the angle text. For example, click **300**°.

c) Select the orientation attribute, and use the right or left arrow key to change it.

d) Press **Esc** to close the Attributes tool.



Moving a Measured Value

▶ Drag the measurement to the desired location.

Note: If you move a measurement too far from its object, it stops following the object. However, its value continues to be updated as you manipulate the object.

Editing a Measured Length

You can set the length of a side of a Triangle, Rectangle, or Polygon by editing its measured value.

▶ Double-click the measurement, and then enter the new value.

Storing a Measured Value as a Variable

Use this method to create a variable and assign a measured value to it.

1. Display the item's context menu, and select **Store**.
2. Type a variable name for the stored measurement.

Linking a Measured Length to an Existing Variable

Use this method to assign a measured length value to an existing variable.

1. Display the measurement's context menu, and select **Variables > Link to**.

   The menu shows the list of currently defined variables.

2. Click the name of the variable you want to link to.

Deleting a Measurement

▶ Display the measurement's context menu, and select **Delete**.

Locking or Unlocking a Measurement

1. Display the measurement's context menu, and select **Attributes**.
2. Use the up/down arrow keys to highlight the Lock attribute.
3. Use the left/right arrow keys to close or open the lock.

   As long as the value remains locked, manipulations are not allowed that would require the measurement to change.

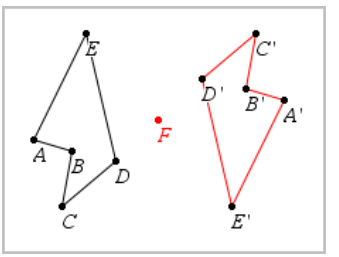
Transforming Objects

You can apply transformations to drawn objects in both the Graphs and Geometry applications. If the object's points are labeled, the corresponding points in the transformed object are labeled using prime notation ($A \rightarrow A'$). To enable automatic labeling of certain objects, see *What You Must Know* in this chapter.

Exploring Symmetry

1. From the **Transformation** menu, select **Symmetry**. (In the Graphs application, click **Geometry > Transformation > Symmetry**.)
2. Click the object whose symmetry you want to explore.
3. Click a location or existing point to establish the point of symmetry.

   A symmetrical image of the object is displayed.



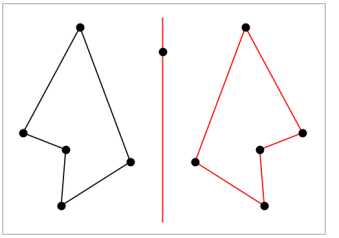
4. Manipulate the original object or the point of symmetry to explore the symmetry.

Exploring Reflection

1. Create a line or segment to predefine the line about which the object will be reflected.

2. From the **Transformation** menu, select **Reflection**. (In the Graphs application, click **Geometry > Transformation > Reflection**.)
3. Click the object whose reflection you want to explore.
4. Click the predefined reflection line or segment.

   A reflected image of the object is displayed.

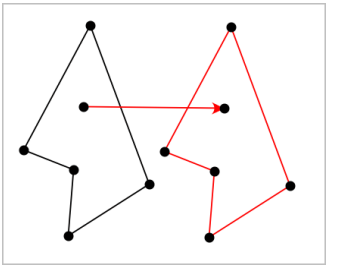


5. Manipulate the original object or the line of symmetry to explore the reflection.

Exploring Translation

1. (Optional) Create a vector to predefine the distance and direction of translation.
2. From the **Transformation** menu, select **Translation**. (In the Graphs application, click **Geometry > Transformation > Translation**.)
3. Click the object whose translation you want to explore.
4. Click the predefined vector.
   —or—
   Click two locations on the work area to indicate the direction and distance of translation.

   A translated image of the object is displayed.

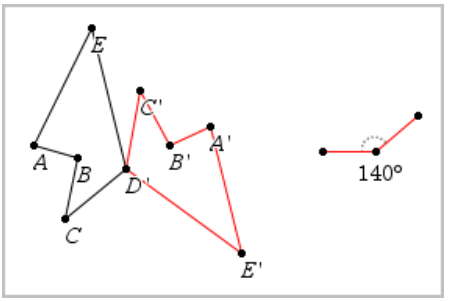


5. Manipulate the original object or the vector to explore the translation.

Exploring Rotation

1. (Optional) Create an angle measurement to serve as a predefined angle of rotation.
2. From the **Transformation** menu, select **Rotation**. (In the Graphs application, click **Geometry > Transformation > Rotation**.)
3. Click the object whose rotation you want to explore.
4. Click a location or point to define the point of rotation.
5. Click the points of the predefined angle.
   —or—
   Click three locations to define an angle of rotation.

   A rotated image of the object is displayed.



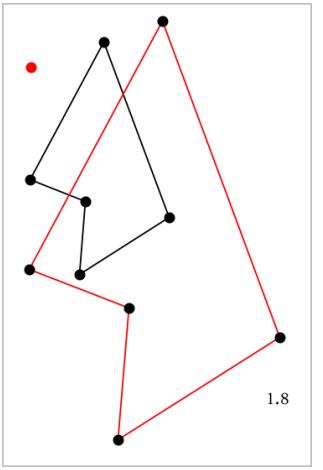
6. Manipulate the original object or the point of rotation to explore the rotation.

Exploring Dilation

1. Create a Text object containing a numeric value to serve as a predefined dilation factor.

   Note: You can also use a measured length value as the dilation factor. Keep in mind that if you use a large value, you may have to pan the display to view the dilated object.
2. From the **Transformation** menu, select **Dilation**. (In the Graphs application, click **Geometry > Transformation > Dilation**.)
3. Click the object whose dilation you want to explore.
4. Click a location or existing point to define the center point of dilation.
5. Click the Text object or measurement that defines the dilation factor.

   A dilated image of the object is displayed.



6. Manipulate the original object or the center point of dilation to explore the dilation. You can also edit the dilation factor.

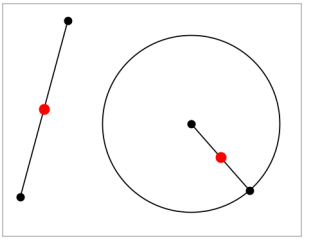
Exploring with Geometric Construction Tools

While a construction is in progress, a tool appears in the work area (for example, **Parallel**). To cancel, press **ESC**.

Creating a Midpoint

This tool lets you bisect a segment or define a midpoint between any two points. The points can be on a single object, on separate objects, or on the work area.

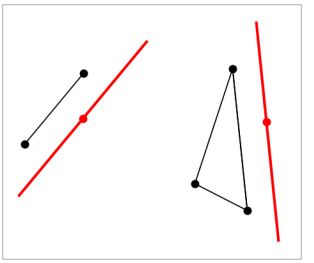
1. From the **Construction** menu, select **Midpoint**. (In the Graphs application, click **Geometry > Construction > Midpoint**.)
2. Click a point or location to define the first point.
3. Click a second point or location to complete the midpoint.



Creating a Parallel Line

This tool creates a parallel line with respect to any existing line. The existing line can be a Graphs axis or any side of a triangle, square, rectangle, or polygon.

1. From the **Construction** menu, select **Parallel**. (In the Graphs application, click **Geometry > Construction > Parallel**.)
2. Click the object that will serve as the reference line.
3. Click a location to create the parallel line.

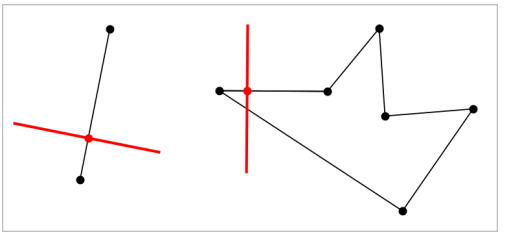


You can drag the parallel line to move it. If you manipulate the reference object, the line remains parallel.

Creating a Perpendicular Line

You can create a line that is perpendicular to a reference line. The reference can be an axis, an existing line, a segment, or one side of a triangle, rectangle, or polygon.

1. From the **Construction** menu, select **Perpendicular**. (In the Graphs application, click **Geometry > Construction > Perpendicular**.)
2. Click a location or existing point through which the perpendicular line should pass.
3. Click the item that will serve as the reference line.

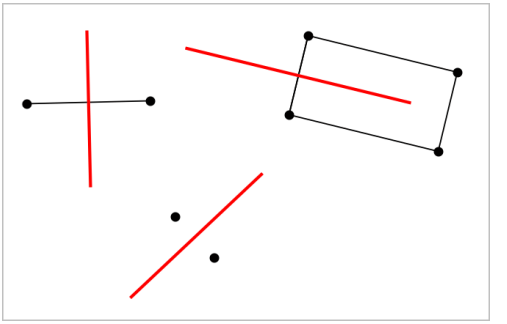


You can drag the intersection point to move the perpendicular. If you manipulate the reference object, the line remains perpendicular.

Creating a Perpendicular Bisector

You can create a perpendicular bisector on a segment, on one side of a triangle, rectangle, or polygon, or between any two points.

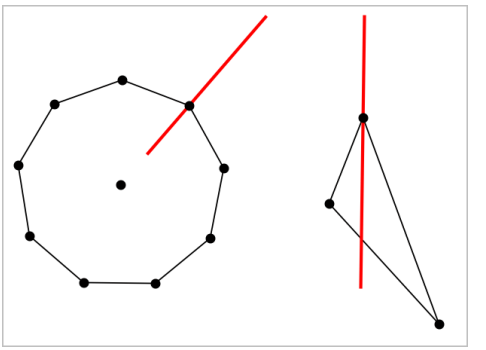
1. From the **Construction** menu, select **Perpendicular Bisector**. (In the Graphs application, click **Geometry > Construction > Perpendicular Bisector**.)
2. Click the item that will serve as the reference line.
   —or—
   Click two points to create a perpendicular bisector between them.



Bisecting an Angle

This tool creates an angle bisector. The points of the angle can be on existing objects, or they can be locations on the work area.

1. From the **Construction** menu, select **Angle Bisector**. (In the Graphs application, click **Geometry > Construction > Angle Bisector**.)
2. Click three locations or points to define the angle. The second click defines the vertex of the angle.

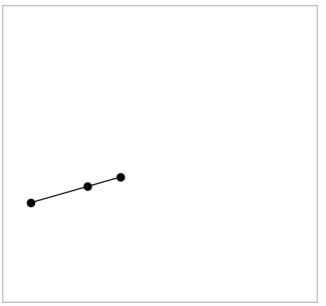


The angle bisector adjusts automatically as you manipulate its defining points.

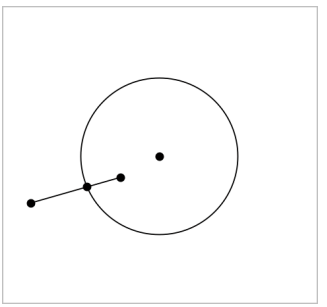
Creating a Locus

The Locus tool enables you to explore the range of motion of one object with respect to another object as constrained by a shared point.

1. Create a segment, line, or circle.
2. Create a point on the segment, line, or circle.



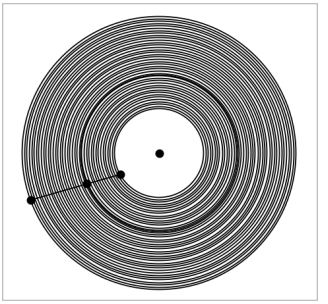
3. Create another object that uses the point created in the previous step.



Circle created to use the defined point on the segment.

4. From the **Construction** menu, select **Locus**. (In the Graphs application, click **Geometry > Construction > Locus**.)
5. Click the point shared by the objects.
6. Click the object defined to share the point (this is the object to vary).

The continuous locus is displayed.

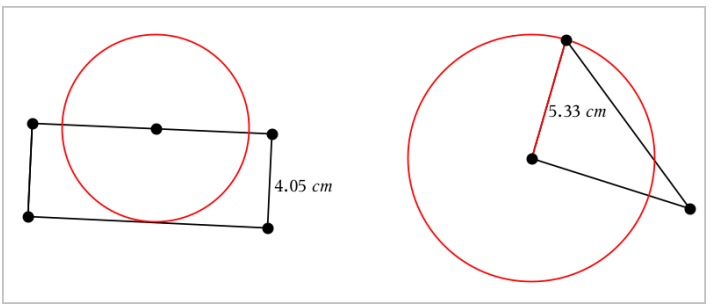


Creating a Compass

This tool operates similarly to a geometric compass used for drawing circles on paper.

1. From the **Construction** menu, select **Compass**. (In the Graphs application, click **Geometry > Construction > Compass**.)
2. To set the width (radius) of the compass:

   Click a segment.
   —or—
   Click any side of a triangle, rectangle, polygon, or regular polygon.
   —or—
   Click any two existing points or locations on the work area.
3. Click a location to establish the center of the circle and complete the construction.



The radius adjusts automatically as you manipulate the original segment, side, or points used to define the radius.

Using Geometry Trace

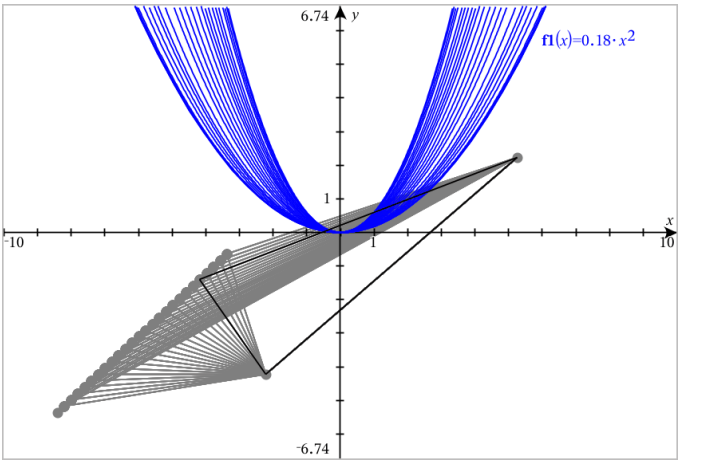
The Geometry Trace tool leaves a visible trail of a geometric object or function graph as it is moved or manipulated. The movement can be done manually or by using animation. This tool is accessible in both the Graphs and Geometry applications.

1. From the **Trace** menu, select **Geometry Trace**.

   The Geometry Trace tool appears.

2. Click the object or function that you want to trace to select it.
3. Drag the object, or play the animation.

   This example shows traces of a graphed function manipulated by dragging and a triangle manipulated by animation.



   Note: You cannot select or manipulate the trace trail.

4. To erase all trails, select **Erase Geometry Trace** from the **Trace** menu.
5. To stop tracing, press **Esc**.

Conditional Attributes

You can cause objects to hide, show, and change color dynamically, based on specified conditions such as "`r1<r2`" or "`sin(a1)>=cos(a2)`."

For example, you might want to hide an object based on a changing measurement that you have assigned to a variable, or you might want an object's color to change based on a "Calculate" result assigned to a variable.

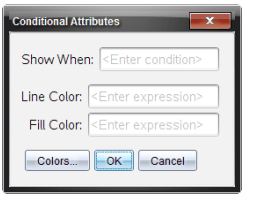
Conditional behaviors can be assigned to objects or groups in the Graphing, Plane Geometry, and 3D Graphing views.

Setting Conditional Attributes of an Object

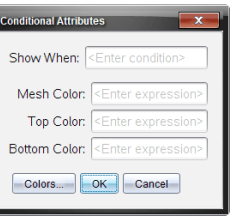
You can set conditions of a selected object either by using its context menu or by activating the Set Conditions tool from the **Actions** menu and then selecting the object. These instructions describe using the context menu.

1. Select the object or group.
2. Display the object's context menu, and click **Conditions**.

   The conditional attributes are displayed.



For 2D objects



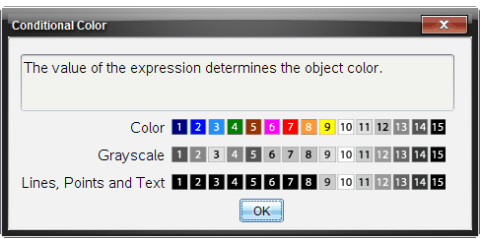
For 3D objects

3. (Optional) In the **Show When** field, enter an expression specifying the conditions during which the object will be shown. Anytime the condition is not satisfied, the object will be hidden.

   You can specify tolerance by using compound conditionals in the **Show When** input field. For example, **`area>=4 and area<=6`**.

   Note: If you need to see conditionally hidden objects temporarily, click **Actions > Hide/Show**. To return to normal viewing, press **ESC**.

4. (Optional) Enter numbers or expressions that evaluate to numbers in the applicable color fields, such as **Line Color** or **Mesh Color**. To see a map of color values, click the **Colors** button.



Map of conditional color values

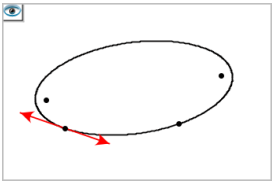
5. Click **OK** in the Conditional Attributes dialog box to apply the conditions.

Hiding Objects in the Geometry Application

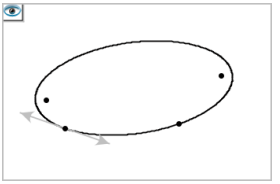
The Hide/Show tool reveals objects you have previously selected as hidden and lets you select which objects to show or hide.

1. From the **Actions** menu, select **Hide/Show**.

   The Hide/Show tool appears, and currently hidden items (if any) are shown dimmed.

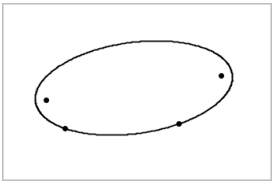


2. Click objects to toggle their hide/show status.



3. Press **Esc** to complete your selections and close the tool.

   All objects you selected as hidden objects disappear.



4. To view the hidden objects temporarily or restore them as shown objects, open the Hide/Show tool.

Customizing the Geometry Work Area

Inserting a Background Image

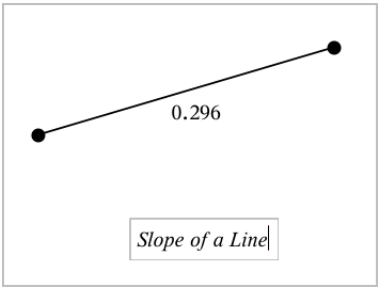
You can insert an image as a background for any Graphs or Geometry page.

1. From the **Insert** menu, click **Image**.
2. Navigate to the image you want to insert, select it, and then click **Open**.

Adding a Text Object to the Work Area

Use the Text tool to add numeric values, formulas, observations, or other explanatory information to the Geometry work area.

1. From the **Actions** menu, select **Text**.
2. Click the location for the text.
3. Type the text in the box that appears, and then press **Enter**.



To move a text object, drag it. To edit the text, double-click it. To delete a text object, display its context menu, and select **Delete**.

Changing the Attributes of Numeric Text

If you enter a numeric value as text, you can lock it or set its format and displayed precision.

1. From the **Actions** menu, select **Attributes**.
2. Click the numeric text to display its list of attributes.
3. Press ▲ and ▼ to move through the list.
4. At each attribute icon, press ◄ or ► to move through the options. For example, select **0** through **9** as the precision.
5. Press **Enter** to apply the changes.
6. Press **Esc** to close the Attributes tool.

Animating Points on Objects

You can animate any point created as a point on an object or graph. Multiple points can be animated simultaneously.

Animating a Point

1. From the **Actions** menu, select **Attributes**.
2. Click the point to display its attributes.
3. Press ▼ to select the animation attributes.
4. Press ◄ or ► to choose either unidirectional or alternating animation.

5. Type a value to set the animation speed. Any nonzero speed begins the animation. To reverse the direction, enter a negative value.
6. Press **Enter** to display the animation controls ⏮ ⏸.
7. Press **ESC** to close the Attributes tool.

Pausing and Resuming All Animations

▶ To pause all animations on a page, click **Pause** ⏸.

▶ To resume all animations, click **Play** ▶.

Resetting All Animations

Resetting pauses all animations and returns all animated points to the positions they occupied when they were first animated.

▶ To reset animation, click **Reset** ⏮.

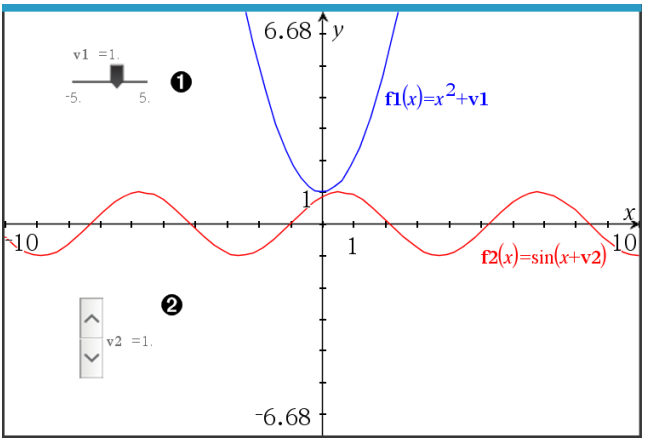
Changing or Stopping the Animation of a Point

1. Click **Reset** ⏮ to stop all animation.
2. From the **Actions** menu, select **Attributes**.
3. Click the point to display its attributes.
4. Select the animation attribute, and type a new animation speed. To stop the point's animation, enter zero.

   Note: If other animated points exist, the animation controls remain in the work area.

Adjusting Variable Values with a Slider

A slider control lets you interactively adjust or animate the value of a numeric variable. You can insert sliders in the Graphs, Geometry, Notes, and Data & Statistics applications.



❶ Horizontal slider for adjusting variable *v1*.

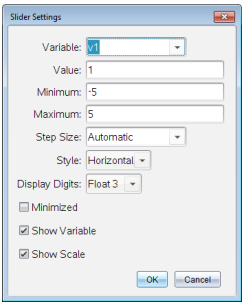
❷ Minimized vertical slider for adjusting variable *v2*.

Note: TI-Nspire™ version 4.2 or higher is required for opening .tns files containing sliders on Notes pages.

Inserting a Slider Manually

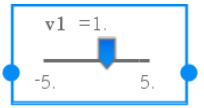
1. From a Graphs, Geometry, or Data & Statistics page, select **Actions > Insert Slider**.
   —or—
   From a Notes page, make sure the cursor is not in a math box or chem box, and then select **Insert > Insert Slider**.

   The Slider Settings screen opens.



2. Enter the desired values, and click **OK**.

   The slider is displayed. On a Graphs, Geometry, or Data & Statistics page, handles are displayed to let you move or stretch the slider.



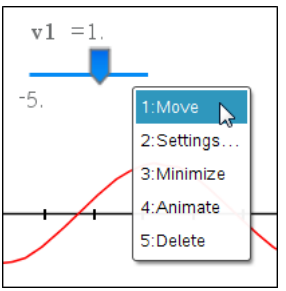
To remove the handles and use the slider, click an empty space in the work area. You can show the handles anytime by selecting **Move** from the slider's context menu.

3. To adjust the variable, slide the pointer (or click the arrows on a minimized slider).
   - You can use the **Tab** key to move the focus to a slider or to move from one slider to the next. The color of the slider changes to show you when it has the focus.
   - When a slider has the focus, you can use the arrow keys to change the value of the variable.

Working with the Slider

Use the options on the context menu to move or delete the slider, and to start or stop its animation. You can also change the slider's settings.

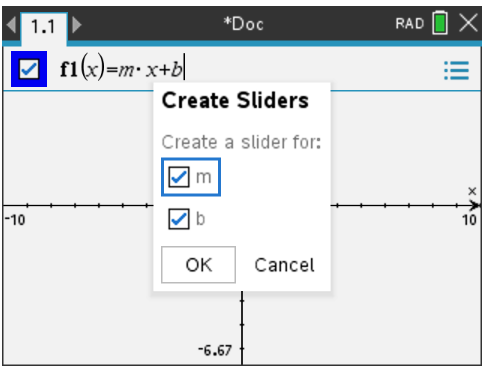
1. Display the slider's context menu.



2. Click an option to select it.

Automatic Sliders in Graphs

Sliders can be created for you automatically in the Graphs application and in the analytic window of the Geometry application. You are offered automatic sliders when you define certain functions, equations, or sequences that refer to undefined variables.



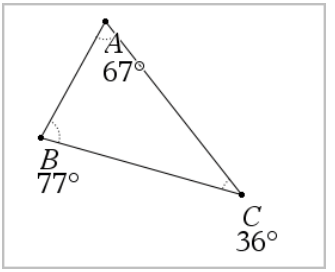
Using the Calculate Tool

The Calculate tool is available in the Graphs and Geometry applications. It lets you evaluate a math expression you have entered as a text object.

The following example uses the Calculate tool to sum the measured angles of a triangle.

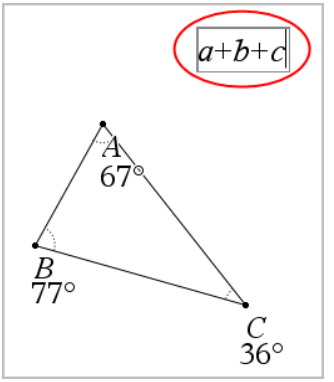
1. Using the **Shapes** menu, create a triangle, and then measure its angles.

   Tip: You can enable options to automatically label points and to force geometric triangle angles to integers. For more information, see *What You Must Know*, in this chapter.



2. From the **Actions** menu, click **Text**.
3. Click a location for the text, and type the formula for the calculation.

   In this example, the formula sums three terms.



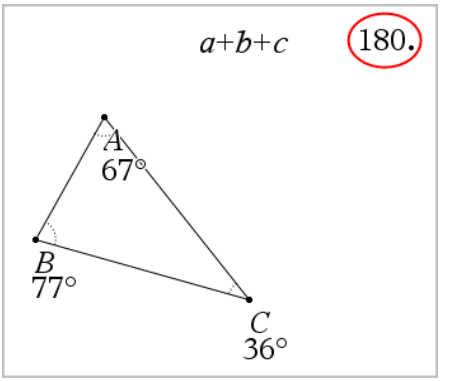
4. From the **Actions** menu, click **Calculate**.
5. Click the formula you created.

   You are prompted to select a value for each term in the formula.

6. Click each angle measurement when prompted.

Note: If you have stored a measurement as a variable, you can select it when prompted by clicking . If the name of a stored measurement matches a term in the formula, you can press “L” when prompted for that term.

After you have selected the third term, the calculation result attaches itself to the pointer.



7. Position the result, and press **Enter** to anchor it as a new text object.

Graphs Application

The Graphs application lets you:

- Graph and explore functions and other relations, such as inequalities, parametrics, polars, sequences, differential equation solutions, and conics.
- Animate points on objects or graphs and explore their behavior.
- Link to data created by other applications.

Adding a Graphs Page

▶ To start a new document with a blank Graphs page:

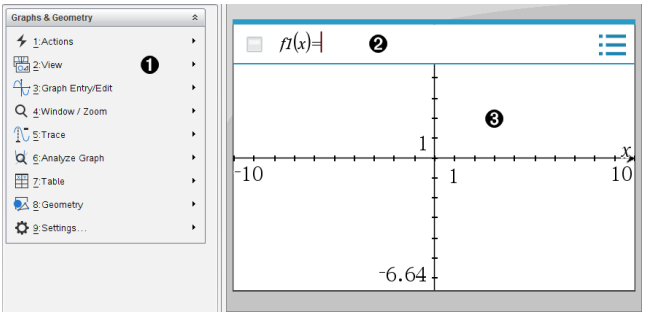
From the main **File** menu, click **New Document**, and then click **Add Graphs**.

Handheld: Press [on], and select **Graphs**.

▶ To add a Graphs page in the current problem of an existing document:

From the toolbar, click **Insert > Graphs**.

Handheld: Press [doc] and select **Insert > Graphs**.



❶ **Graphs & Geometry menu.** Contains tools for defining, viewing, and investigating relations.

❷ **Entry line**. Lets you define the relations that you want to graph. The default graph type is Function, so the form $f1(x)=$ is displayed initially. You can define multiple relations for each of several graph types.

❸ **Graphs Work Area**

- Shows graphs of relations that you define on the entry line.
- Shows points, lines, and shapes that you create with geometry tools.
- Drag the area to pan (affects only those objects created in the Graphs application).

What You Must Know

Changing the Graphs and Geometry Settings

1. From the **Settings** menu in the Documents Toolbox, select **Settings**.
2. Select the settings that you want to use.
   - **Display Digits.** Sets the display format for numbers as Floating or Fixed decimal.
   - **Graphing Angle.** Sets the angle unit for all Graphs and 3D Graphing applications in the current docuument. The default setting is Radian. Set this to Auto if you want graphing angles to follow the Angle setting in the main **File > Settings** menu. An angle mode indicator shows the resulting mode in Graphs and 3D Graphing applications.
   - **Geometry Angle.** Sets the angle unit for all Geometry applications in the current document. The default setting is Degree. Set this to Auto if you want geometry angles to follow the Angle setting in the main **File > Settings** menu. An angle mode indicator shows the resulting mode in Geometry applications.
   - **Grid.** Sets the grid display in the Graphs application. The default setting is No Grid. Dot Grid and Lined Grid are also available.
   - **Automatically hide plot labels.** In the Graphs application, hides the label that normally appears next to a graphed relation.
   - **Show axis end values.** Applies only in the Graphs application.
   - **Show tool tips for function manipulation.** Applies only in the Graphs application.
   - **Automatically find points of interest.** In the Graphs application, shows zeros, minima, and maxima while tracing function graphs.
   - **Force Geometric Triangle Angles to Integers.** Restricts the angles of a triangle to integer values as you create or edit the triangle. This setting applies only in the Geometry View with the Geometry Angle unit set to Degree or Gradian. It does not apply to analytic triangles in Graphing View or to analytic triangles in the Analytic Window of the Geometry View. This setting does not affect existing angles, and it does not apply when constructing a triangle based on previously inserted points. By default, this setting is deselected.
   - **Automatically Label Points.** Applies labels (A, B, ..., Z, A_1, B_1, and so on) to points, lines, and vertices of geometric shapes as you draw them. The labeling sequence starts at A for each page in a document. By default, this setting is deselected.

     Note: If you create a new object that uses existing unlabeled points, those point are not automatically labeled in the completed object.

- Click **Restore** to restore all settings to their factory defaults.
- Click **Make Default** to apply the current settings to the open document and save them as the default for new Graphs and Geometry documents.

Using Context Menus

Context menus provide quick access to commonly used commands and tools that apply to a specific object. For example, you can use a context menu to change an object's line color or to group a set of selected objects.

▶ Display the context menu for an object in one of the following ways.

- Windows®: Right-click the object.
- Mac®: Hold ⌘ and click the object.
- Handheld: Move the pointer to the object, and then press ctrl menu.

Finding Hidden Objects in the Graphs or Geometry Application

You can hide and show individual graphs, geometric objects, text, labels, measurements, and axis end-values.

To temporarily view hidden graphs or objects or to restore them as shown objects:

1. From the **Actions** menu, select **Hide/Show**.

   The Hide/Show tool appears in the work area, and all hidden objects become visible in dimmed colors.

2. Click a graph or object to toggle its Hide/Show state.
3. To apply the changes and close the Hide/Show tool, press **ESC**.

Inserting a Background Image

You can insert an image as a background for a Graphs or Geometry page. The file format of the image can be .bmp, .jpg, or .png.

1. From the **Insert** menu, click **Image**.
2. Navigate to the image you want to insert, select it, and then click **Open**.

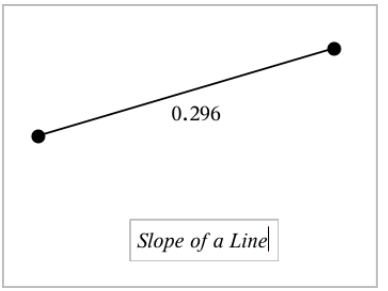
For information on moving, resizing, and deleting a background image, see *Working with Images in the Software*.

Adding Text to the Graphs or Geometry Work Area

1. From the **Actions** menu, select **Text**.

The Text tool appears in the work area.

2. Click the location for the text.
3. Type the text in the box that appears, and then press **Enter**.



4. To close the Text tool, press **ESC**.
5. To edit the text, double-click it.

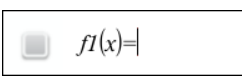
Deleting a Relation and its Graph

1. Select the relation by clicking its graph.
2. Press **Backspace** or **DEL**.

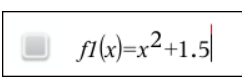
   The graph is removed from both the work area and the graph history.

Graphing Functions

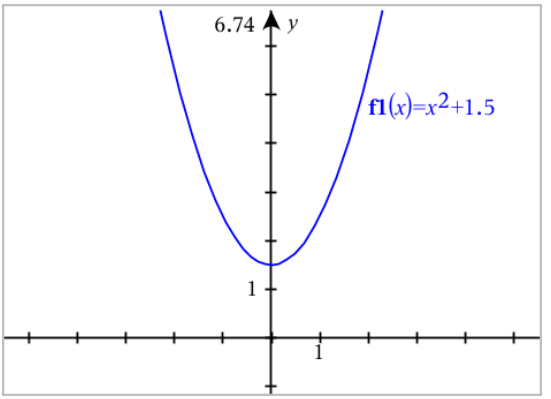
1. From the **Graph Entry/Edit** menu, select **Function**.



2. Type an expression for the function.



3. Press **Enter** to graph the function.



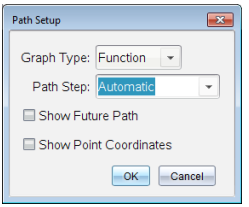
Note: For information about path plots, see Exploring Graphs with Path Plot.

Exploring Graphs with Path Plot

Path Plot lets you animate function, parametric, and polar equation plots in real time to analyze how they are plotted and not just the final plot.

Changing the Path Plot Settings

1. From the **Trace** menu, select **Path Plot > Path Setup**.

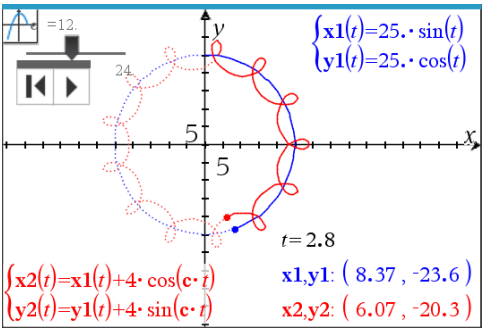


2. Select the settings you want to use.
   - **Graph Type:** Selects Function, Parametric, or Polar as the graph type.
   - **Path Step:** Sets the increment of the independent variable at which values are plotted.
   - **Show Future Path:** Toggles the display of all future points for each function past the starting or current point of the graph. You can also toggle this when viewing the graph with the Up/Down arrow keys.
   - **Show Point Coordinates:** Toggles the display of the coordinates for recorded trace points.

Enabling Path Plot

1. Enter your equation(s).
2. From the **Trace** menu, select **Path Plot > Function/Parametric/Polar**.
3. Navigate through the animation by:

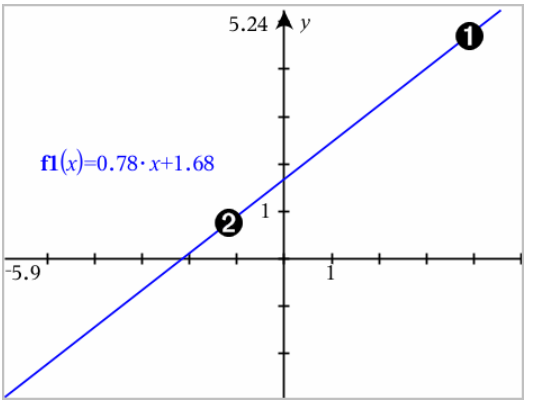
- using the Play/Pause/Reset Animation icons
- using the Left/Right arrow keys
- entering a number to jump to that point



4. Press the **Esc** key to exit the animation.

Manipulating Functions by Dragging

Some types of functions can be translated, stretched, and/or rotated by dragging parts of the graph. As you drag, the expression for the graph updates to reflect the change.

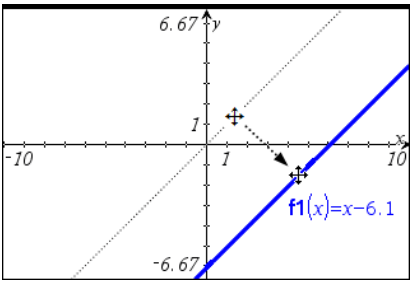


1 Drag graph from the ends to rotate.

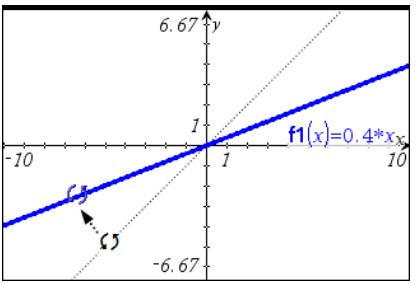
2 Drag graph near the middle to translate.

Manipulating a Linear Function

▶ To translate, grab near the middle of the graph, and then drag.

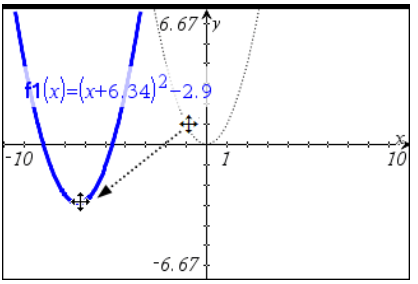


▶ To rotate, grab near the ends of the graph, and then drag.

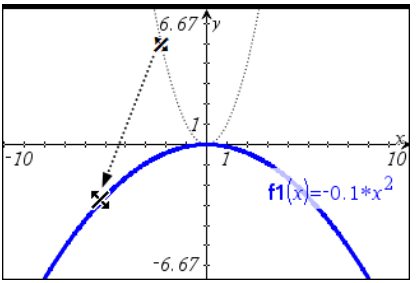


Manipulating a Quadratic Function

▶ To translate, grab near the vertex of the graph, and then drag.

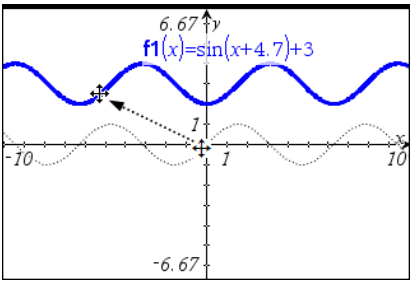


▶ To stretch, grab away from the vertex of the graph, and then drag.

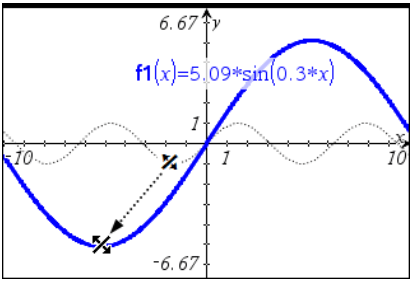


Manipulating a Sine or Cosine Function

▶ To translate, grab near the axis of vertical symmetry of the graph, and then drag.



▶ To stretch, grab away from the axis of vertical symmetry of the graph, and then drag.



Specifying a Function with Domain Restrictions

You can use the entry line or the Calculator application to specify a function with domain restrictions. For multiple domain restrictions on a function, use the **piecewise()** function.

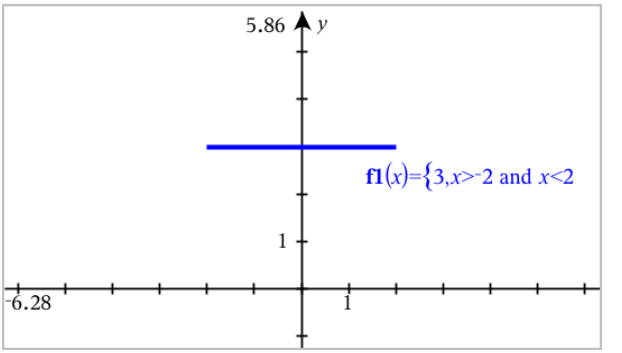
In the following example, a function with a domain that is less than 2 and greater than -2 is specified on the entry line:

1. From the **Graph Entry/Edit** menu, select **Function**.

2. Type the following on the entry line, using spaces to separate the "**and**" operator:

   `piecewise(3,x>-2 and x<2)`

3. Tap **Enter** to graph the function.



Finding Points of Interest on a Function Graph

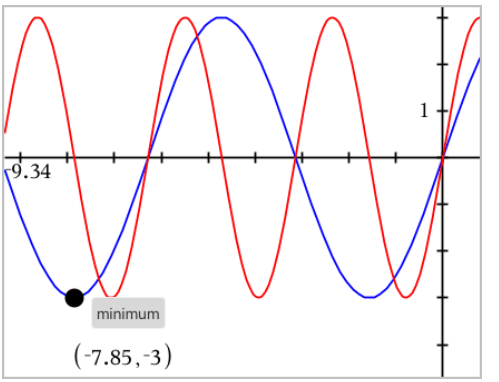
The Graphs application helps you find zeros, minimums, maximums, intersections, derivatives (dy/dx), or integrals. For Graphs defined as conic sections, you can also find foci, directrix, and other points.

(CAS): You can also find the point of inflection.

Identifying Points of Interest by Dragging a Point

▶ To quickly identify maximums, minimums, and zeros, create a point on the graph and then drag the point.

Temporary signposts appear as you drag through points of interest.

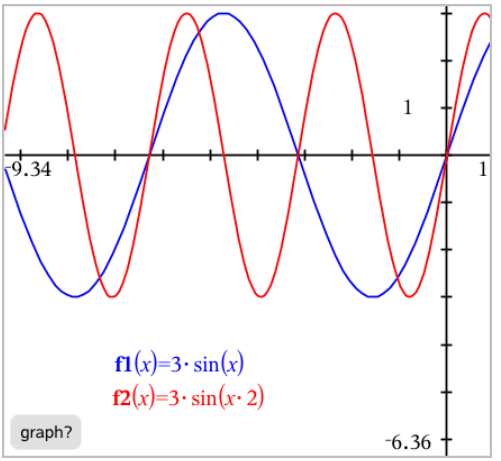


Identifying Points of Interest with Analysis Tools

This example illustrates using the Minimum tool. Other analysis tools operate similarly.

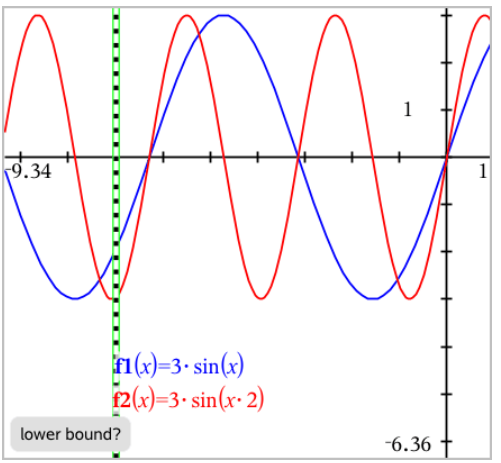
1. From the **Analyze Graph** menu, select **Minimum**.

   The Minimum icon is displayed at the top left on the work area, and a **graph?** prompt appears in the work area.

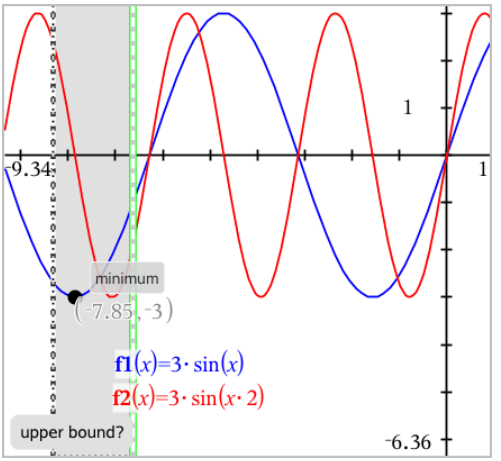


2. Click the graph on which you want to find the minimum.

   A dotted line appears, representing the lower bound of the range to search.

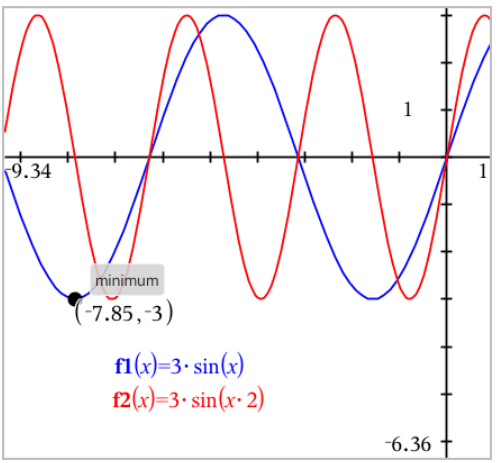


3. Drag the line or click a location to set the lower bound and display a proposed upper bound.



4. Drag the line representing the upper bound, or click a location to set it.

   The minimum is displayed, along with a text object showing its coordinates.



Graphing a Family of Functions

In a family of functions, each member has its own value for one or more of the parameters. By entering the parameters as lists, you can use a single expression to graph a family of up to 16 functions.

For example, the expression f1(x) = **{-1,0,1,2}** • x + **{2,4,6,8}** denotes the following four functions:

$f1\_1(x)$ = **-1** • x + **2**
$f1\_2(x)$ = **0** • x + **4**

$f1\_3(x) = \mathbf{1} \cdot x + \mathbf{6}$
$f1\_4(x) = \mathbf{2} \cdot x + \mathbf{8}$

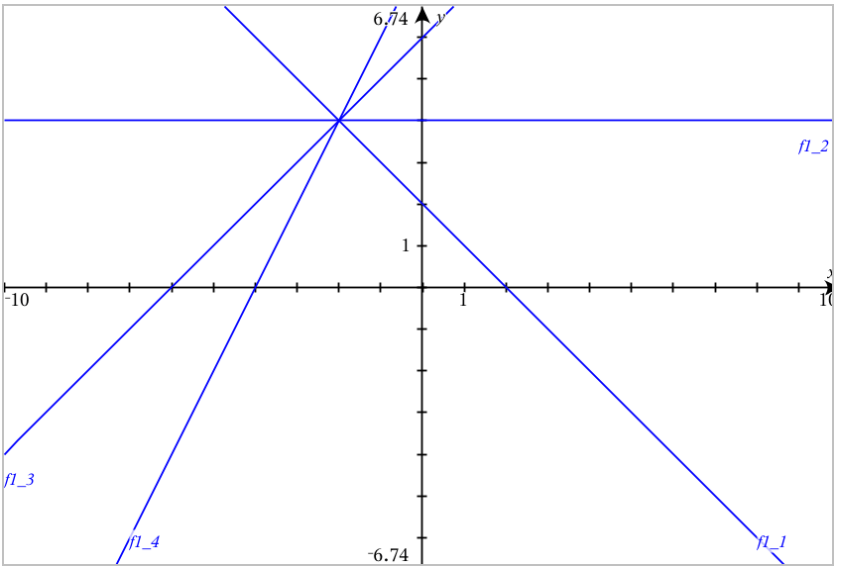
To Graph a Family of Functions

1. From the **Graph Entry/Edit** menu, select **Function**.
2. Type the expression, using lists to represent the members of the family.

$$\mathbf{f1}(x)=\{-1,0,1,2\}\cdot x+\{2,4,6,8\}$$

3. Press **Enter** to graph the functions.

   Each member is labeled separately (*f1_1*, *f1_2*, and so on) to indicate its sequence in the expression.

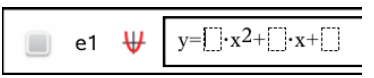


Note: You cannot edit a single function graph to change it to a family of functions.

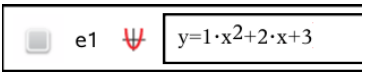
Graphing Equations

1. From the **Graph Entry/Edit** menu, select **Equation Templates**.
2. Click the type of equation (**Line**, **Parabola**, **Circle**, **Ellipse**, **Hyperbola**, or **Conic**).
3. Click the specific template for the equation. For example, tap **y=a•x²+b•x+c** to define a parabola.

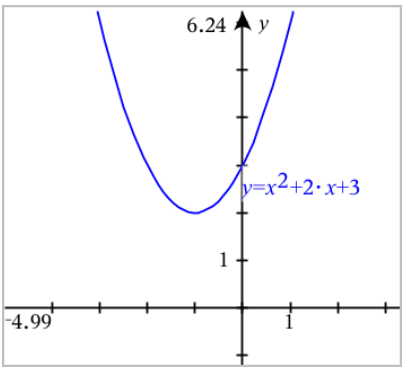
   The entry line includes a symbol to indicate the type of equation.



4. Type the coefficients into the equation template.



5. Press **Enter**.



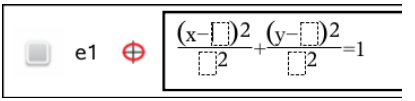
Graphing Conic Sections

The Graphing view lets you graph and explore linear and conic equations analytically in a two-dimensional coordinate system. You can create and analyze lines, circles, ellipses, parabolas, hyperbolas, and general conic equations.

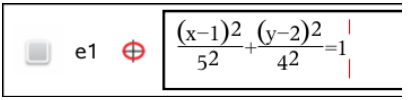
The entry line makes it easy to enter the equation by displaying a template for the type of equation you choose.

Example: Creating a conic ellipse

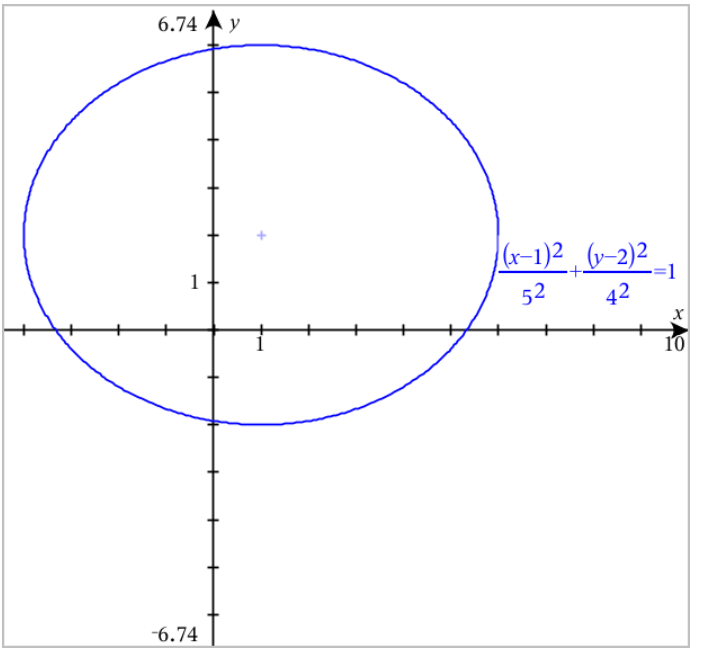
1. From the **Graph Entry/Edit** menu, select **Equation Templates > Ellipse**, and tap the equation type.



2. Type initial values for the coefficients in the provided spaces. Use the arrow keys to move among the coefficients.

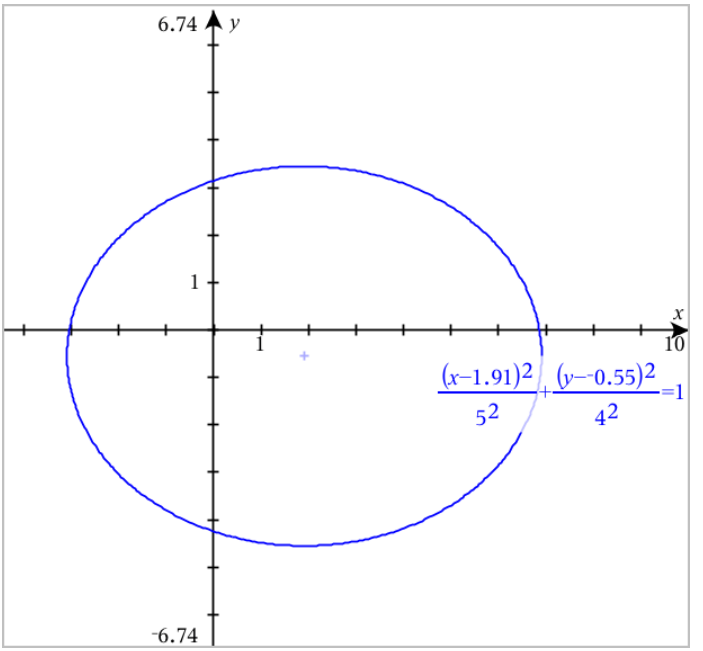


3. Press **Enter** to graph the equation.



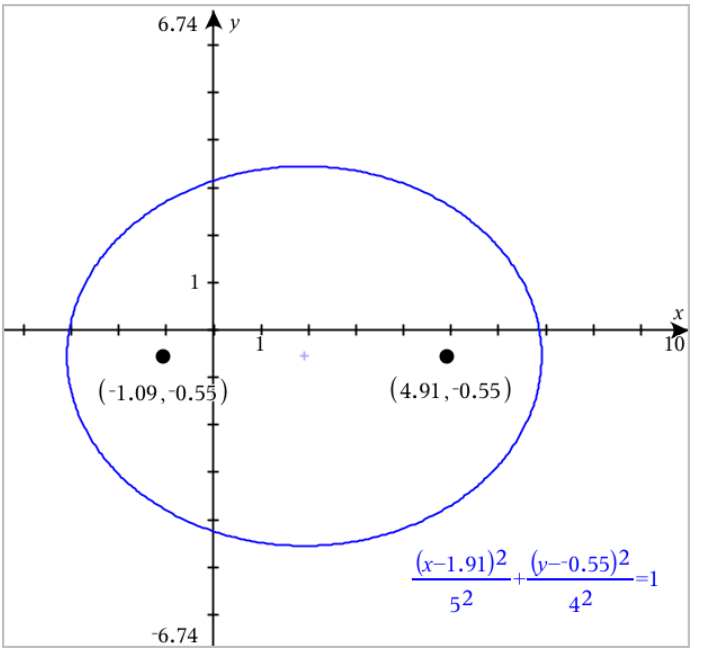
Exploring the sample ellipse

1. Drag the ellipse from its center to explore the effect of translation on the equation.

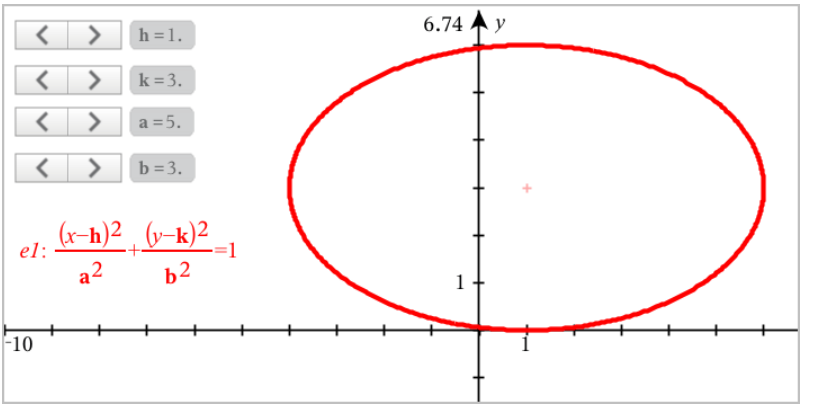


2. Use the analysis tools, such as **Analyze Graph > Analyze Conics > Foci** to further explore the graph.

   Note: The type of conic determines which analysis tools you can use. In the case of the ellipse, you can obtain its center, vertices, foci, axes of symmetry, directrices, eccentricity, and latera recta.



3. To explore translation and dilation interactively, define a conic ellipse that uses variables for the *h*, *k*, *a*, and *b* coefficients. Insert sliders to vary the parameters.



Graphing Relations

Relation graphing is available on Graphs pages and in the Analytic Window of Geometry pages.

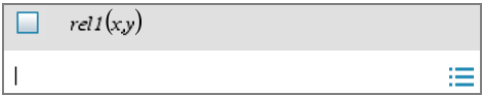
You can define relations using ≤, <, =, >, or ≥. The inequality operator (≠) is not supported in relation graphing.

Relation type	Examples
Equations and inequalities equivalent to y = f(x)	• y = sqrt(x) • y-sqrt(x) = 1/2 • -2*y-sqrt(x) = 1/2 • y-sqrt(x) ≥ 1/2 • -2*y-sqrt(x) ≥ 1/2
Equations and inequalities equivalent to x = g(y)	• x = sin(y) • x-sin(y) = 1/2 • x-sin(y) ≥ 1/2
Polynomial equations and inequalities	• x^2+y^2 = 5 • x^2-y^2 ≥ 1/2+y • $x^3+y^3-6*x*y=0$
The above relations on domains restricted by rectangles	• y=sin(x) and -2π<x≤2π • y≤x2|y≥-2 and 0≤x≤3 • {x^2+y^2≤3, y≥0 and x≤0

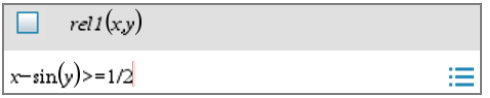
Note: Restrictions imposed by an active Press-to-Test session may limit the types of relations you can graph.

To Graph a Relation:

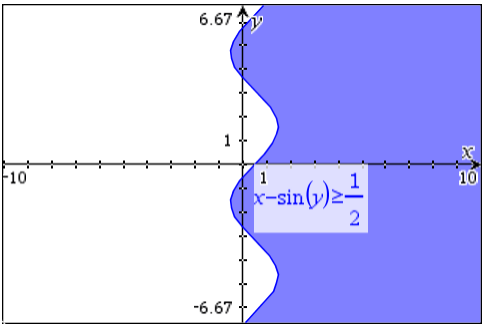
1. From the **Graph Entry/Edit** menu, select **Relation**.



2. Type an expression for the relation.



3. Press **Enter** to graph the relation.



Tips for Graphing Relations

- You can quickly define a relation from the Function entry line. Position the cursor to the immediate right of the = sign, and then press the **Backspace** key. A small menu appears with the relation operators and a **Relation** option. Choosing from the menu places the cursor in the Relation entry line.
- You can type a relation as text on a Graphs page and then drag the text object over either axis. The relation is graphed and added to the relation history.

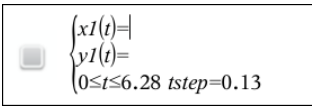
Warning and Error Message

Error Condition	Additional Information
Relation input not supported	**Relation input not supported** **Note:** The following relation inputs are supported: • Relations using ≤, <, =, >, or ≥. • Polynomial relations in x and y • Relations equivalent to y=f(x) or x=g(y) or corresponding inequalities • The above relations on domains restricted by rectangles
Domain Restrictions not supported for certain classes of relations equivalent to y=f(x) or x=g(y) or corresponding inequalities.	• Relations equivalent to y=f(x) and corresponding inequalities can only have constraints on x • For example: y=√(x) and 0≤x≤1 will work but y=√(x) and 0≤y≤1 will not • Relations equivalent to x=g(y) and corresponding inequalities can only have constraints on y • For example: x=sin(y)|−1≤y≤1 will work but x=sin(y)|−1≤x≤1 will not

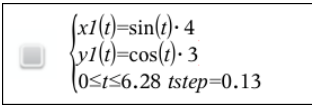
Graphing Parametric Equations

1. From the **Graph Entry/Edit** menu, select **Parametric**.

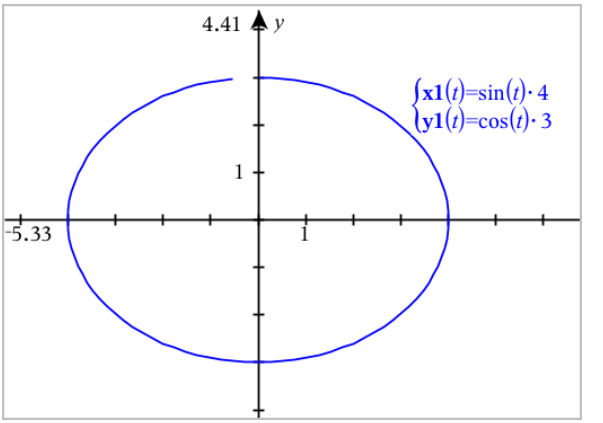
   Use the up and down arrow keys to move among the fields in the Parametric entry line.



2. Type expressions for $xn(t)$ and $yn(t)$.



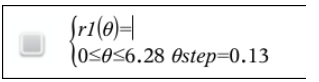
3. (Optional) Edit the default values for *tmin*, *tmax*, and *tstep*.
4. Press **Enter**.



Note: For information about path plots, see Exploring Graphs with Path Plot.

Graphing Polar Equations

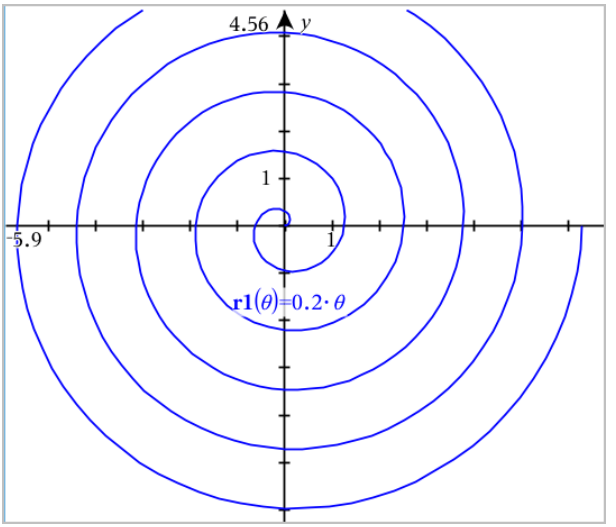
1. From the **Graph Entry/Edit** menu, select **Polar**.



2. Type an expression for $rn(\theta)$.
3. (Optional) Edit the default values for θmin, θmax, and $\theta step$.

$$\begin{cases} r1(\theta)=.2\cdot\theta \\ 0\le\theta\le(\pi\cdot 10)\ \theta step=0.13 \end{cases}$$

4. Press **Enter**.



Note: For information about path plots, see Exploring Graphs with Path Plot.

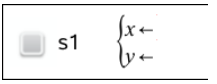
Graphing Scatter Plots

1. (Optional) Create two predefined list variables containing the x and y values to plot. You can use the Lists & Spreadsheet, Calculator, or Notes application to create the lists.

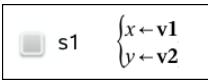
A v1	B v2	C	D
1	2		
2	4		
3	8		
4	16		
5	32		

2. From the **Graph Entry/Edit** menu, select **Scatter Plot**.

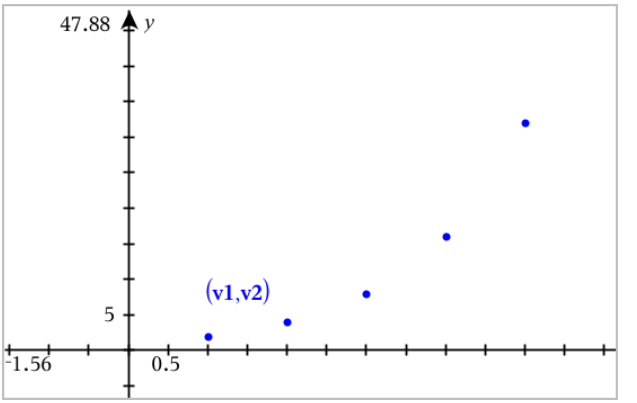
   Use the up and down arrow keys to move between the x and y fields.



3. Use one of the following methods to specify lists to plot as x and y.
   - Click var to select names of the predefined list variables.
   - Type the names of the variables, such as **v1**.
   - Type lists as comma-separated elements enclosed within brackets, for example: {1,2,3}.



4. Press **Enter** to plot the data, and then zoom the work area to view the plotted data.

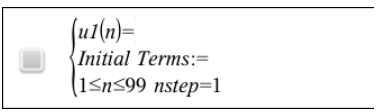


Plotting Sequences

The Graphs application lets you plot two types of sequences. Each type has a separate template for defining the sequence.

Defining a Sequence

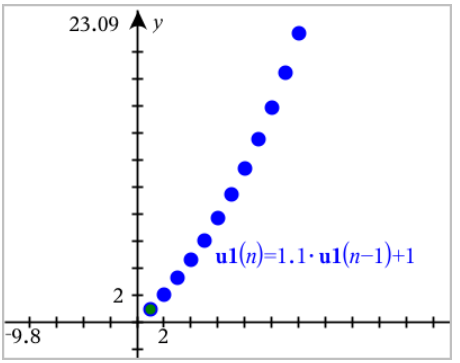
1. From the **Graph Entry/Edit** menu, select **Sequence > Sequence**.



2. Type the expression to define the sequence. Update the independent variable field to m+1, m+2, etc., if necessary.
3. Type an initial term. If the sequence expression references more than one prior term, such as *u1(n-1)* and *u1(n-2)*, (or *u1(n)* and *u1(n+1)*), separate the terms with commas.

$$\begin{cases} u1(n)=1.1\cdot u1(n-1)+1 \\ Initial\ Terms:=1 \\ 1\le n\le 99\ nstep=1 \end{cases}$$

4. Press **Enter**.



Defining a Custom Sequence

A custom sequence plot shows the relationship between two sequences by plotting one on the x axis and the other on the y axis.

This example simulates the Predator-Prey model from biology.

1. Use the relations shown here to define two sequences: one for a rabbit population, and another for a fox population. Replace the default sequence names with **rabbit** and **fox**.

$$\begin{cases} \mathbf{rabbit}(n)=\mathbf{rabbit}(n-1)\cdot(1+0.05-0.001\cdot\mathbf{fox}(n-1)) \\ Initial\ Terms:=200 \\ 1\le n\le 400\ nstep=1 \end{cases}$$

$$\begin{cases} \mathbf{fox}(n)=\mathbf{fox}(n-1)\cdot(1+2.E{-}4\cdot\mathbf{rabbit}(n-1)-0.03) \\ Initial\ Terms:=50 \\ 1\le n\le 400\ nstep=1 \end{cases}$$

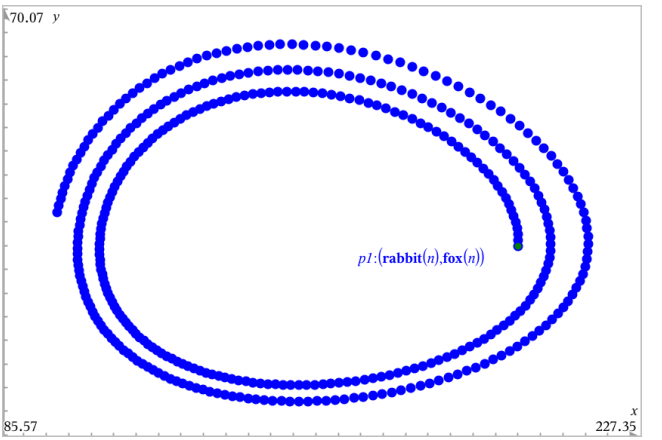
.05 = the growth rate of rabbits if there are no foxes
.001 = the rate at which foxes can kill rabbits
.0002 = the growth rate of foxes if there are rabbits
.03 = the death rate of foxes if there are no rabbits

Note: If you want to see the plots of the two sequences, zoom the window to the **Zoom - Fit** setting.

2. From the **Graph Entry/Edit** menu, select **Sequence > Custom**.
3. Specify the **rabbit** and **fox** sequences to plot on the x and y axes, respectively.

p1 $\begin{cases} x \leftarrow \mathbf{rabbit}(n) \\ y \leftarrow \mathbf{fox}(n) \\ 1 \le n \le 400 \ \ nstep=1 \end{cases}$

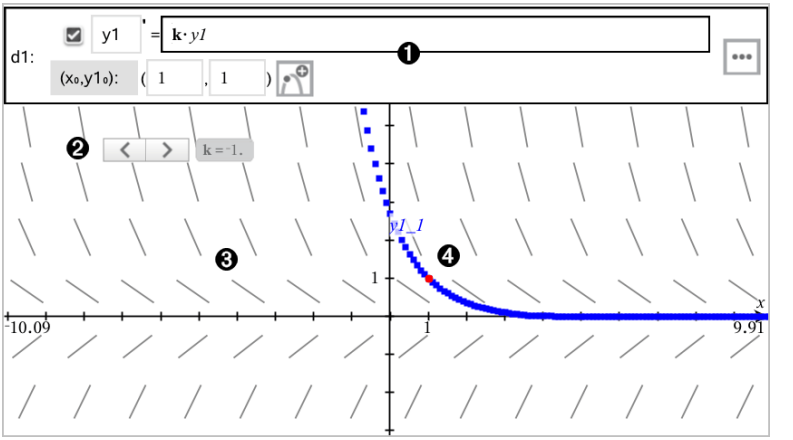
4. Press **Enter** to create the custom plot.
5. Zoom the window to the **Zoom - Fit** setting.



6. Explore the custom plot by dragging the point that represents the initial term.

Graphing Differential Equations

You can study linear and non-linear differential equations and systems of ordinary differential equations (ODEs), including logistic models and Lotka-Volterra equations (predator-prey models). You can also plot slope and direction fields with interactive implementations of Euler and Runge-Kutta methods.



❶ ODE entry line:
- **y1** ODE identifier
- Expression **k·y1** defines the relation
- Fields (**1**,**1**) for specifying initial condition
- Buttons for adding initial conditions and setting plot parameters

❷ Slider to vary coefficient **k** of the ODE

❸ Slope field

❹ A solution curve passing through the initial condition

To Graph a Differential Equation:

1. From the **Graph Entry/Edit** menu, select **Diff Eq**.

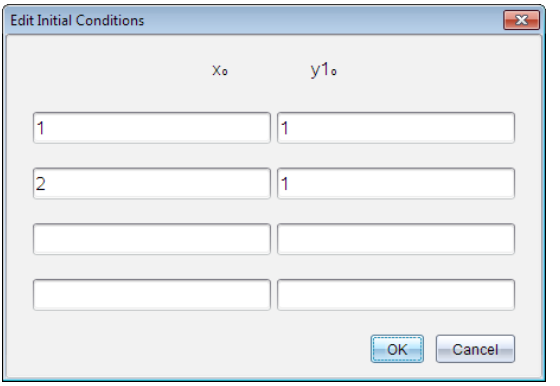
   The ODE is automatically assigned an identifier, such as "y1."

2. Move to the relation field and enter the expression that defines the relation. For example, you might enter -y1+0.1*y1*y2.

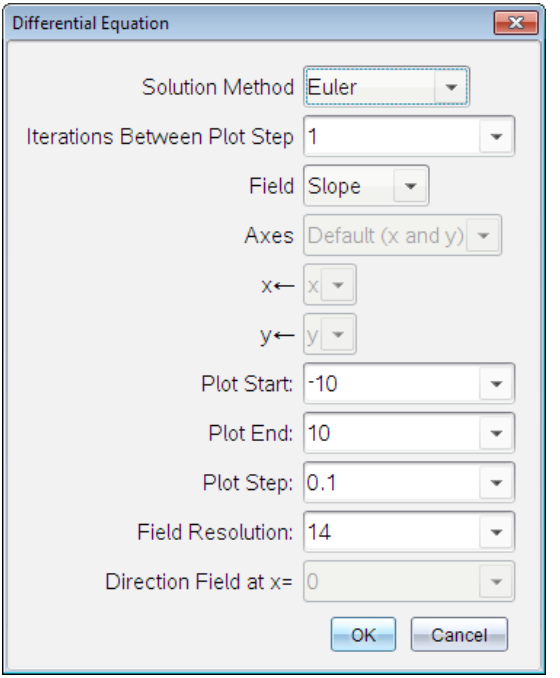
3. Enter the initial condition for the independent value x_0 and for $y1_0$.

   Note: The x_0 value(s) are common to all the ODEs in a problem but can be entered or modified only in the first ODE.

4. (Optional) To study multiple initial conditions for the current ODE, click Add Initial Conditions and enter the conditions.



5. Tap Edit Parameters to set the plot parameters. Select a numerical Solution Method, and then set any additional parameters. You can change these parameters anytime.



6. Click **OK**.
7. To enter additional ODEs, press the down arrow to display the next ODE edit field.

As you move among defined ODEs, the graph is updated to reflect any changes. One solution to the ODE is graphed for each IC specified for each shown ODE (selected by check box).

Summary of Differential Equation Settings

Solution Method	Selects Euler or Runge-Kutta as the numerical solution method.
Iterations Between Plot Step	Computational accuracy for Euler solution method only. Must be an integer value >0. To restore the default, select the down-arrow and select **Default**.
Error Tolerance	Computational accuracy for Runge-Kutta solution method only. Must be a floating-point value $\geq 1 \times 10^{-14}$. To restore the default, select the down-arrow and select **Default**.
Field	**None** - No field is plotted. Available for any number of ODEs, but required if three or more 1st-order ODEs are active. Graphs a combination of the solution and/or values of one or more ODEs (according to user-configured **Axes** settings). **Slope** - Plots a field representing the family of solutions to a single 1st-order ODE. Exactly one ODE must be active. Sets **Axes** to **Default (x and y)**. Sets Horizontal axis to x (the independent variable). Sets Vertical axis to y (the solution to the ODE). **Direction** - Graphs a field in the phase plane representing the relationship between a solution and/or values of a system of two 1st-order ODEs (as specified by the **CustomAxes** setting). Exactly two ODEs must be active.
Axes	**Default (x and y)** - Plots x on the x axis and y (the solutions to the active differential equations) on the y axis. **Custom** - Lets you select the values to be plotted on the x and y axes respectively. Valid entries include: • **x** (the independent variable) • **y1**, **y2**, and any identifiers defined in the ODE editor • **y1'**, **y2'**, and any derivatives defined in the ODE editor
Plot Start	Sets the independent variable value at which the solution plot starts.
Plot End	Sets the independent variable value at which the solution plot stops.
Plot Step	Sets the increment of the independent variable at which values are plotted.
Field Resolution	Sets the number of columns of field rendering elements (line segments) used to draw a slope or direction field. You can change this parameter only if **Field** = **Direction** or **Slope**.
Direction Field at x=	Sets the independent variable value at which a direction field is drawn when plotting non-autonomous equations (those that refer to x). Ignored when plotting autonomous equations. You can change this parameter only if **Field** = **Direction**.

Viewing Tables from the Graphs Application

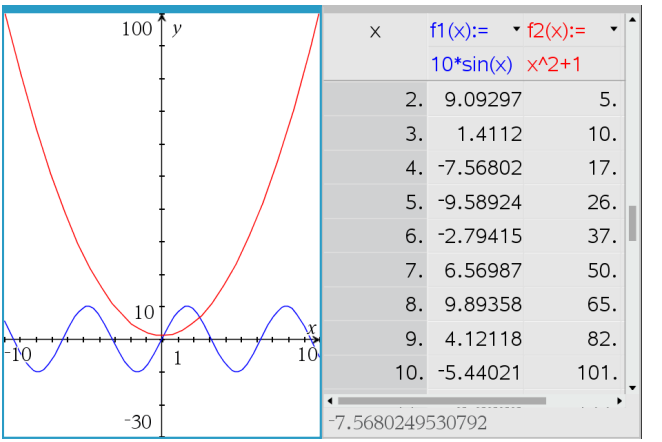
You can show a table of values for any relation defined in the current problem.

Note: For details about using tables and instructions for accessing tables from the Lists & Spreadsheet application, see Working with Tables.

Showing a Table

▶ From the **Table** menu, select **Split-screen Table**.

The table is displayed with columns of values for the currently defined relations.



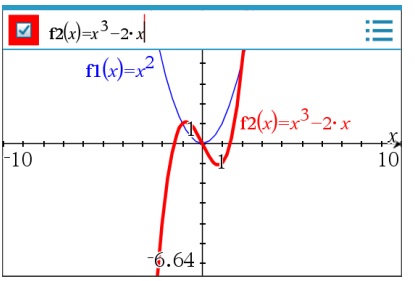
To change which relation is displayed in a column, click the arrow in the top cell of the column, and then select the relation name.

Hiding the Table

▶ From the **Table** menu, select **Remove Table**.

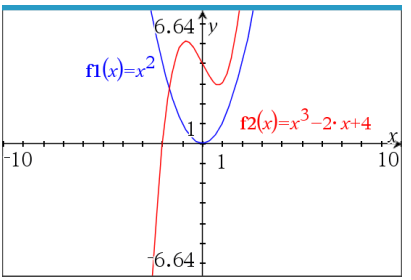
Editing Relations

1. Double-click the graph to show its expression in the entry line.
   —or—
   Display the graph's context menu, and then click **Edit Relation**.



2. Modify the expression as needed.

3. Press enter to graph the revised function.



Renaming a Relation

Each relation type has a default naming convention. For example, the default name for functions is *fn*(*x*). (The number represented by *n* increases as you create more functions.) You can replace the default name with a name of your choice.

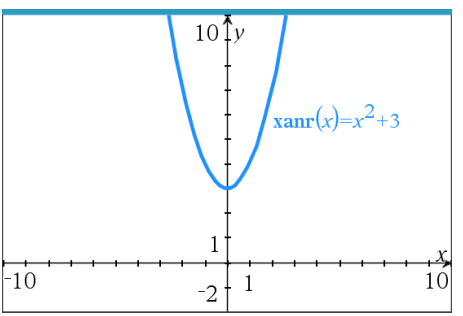
Note: If you want to use a custom name as a convention, you must enter it manually for each function.

1. In the entry line, delete the existing name. For example, delete the "*f1*" from "*f1*(*x*)". You can use the right and left arrow keys to position the cursor.

2. Type the replacement name.

3. If you are defining a new relation, position the cursor after the = sign and type the expression.

4. Press **Enter** to graph the relation with its new name.



Accessing the Graph History

For each problem, the software stores a history of relations defined in the Graphs application and 3D Graphing view, such as function graphs **f1** through **f99** and 3D function graphs **z1** through **z99**. You can view and edit these items using a button on the entry line.

Viewing the History

1. Press **Ctrl+G** to show the entry line.
2. Click the **History Menu** button on the entry line.

   The menu is displayed. As you point to the name of each item, its expression appears in the entry line.

3. Select the name of the relation you want to view or edit.
4. (Optional) From the entry line, use the up and down arrow keys to scroll through the defined relations of the same type.

Viewing the History of Specific Relation Types

Use this method if you want to view or edit a defined relation that does not appear in the History menu.

1. On the **Graph Entry/Edit** menu, click the relation type. For example, click **Polar** to show the entry line for the next available Polar relation.
2. Click the **History Menu** button, or use the up and down arrow keys to scroll through the defined relations of the same type.

Zooming/Rescaling the Graphs Work Area

Rescaling in the Graphs application affects only the graphs, plots, and objects that reside in the Graphing view. It has no effect on objects in the underlying Plane Geometry view.

Rescaling by Dragging Along an Axis

- To rescale the x and y axes proportionally, drag a tic mark on either axis.
- To rescale only one axis, hold down **Shift** and drag a tic mark on the axis.

Zooming Using a Zoom Tool

- From the **Window / Zoom** menu, select one of the tools.
  - **Zoom - Box** (Click two corners of a box to define the area to show.)
  - **Zoom - In**
  - **Zoom - Out**

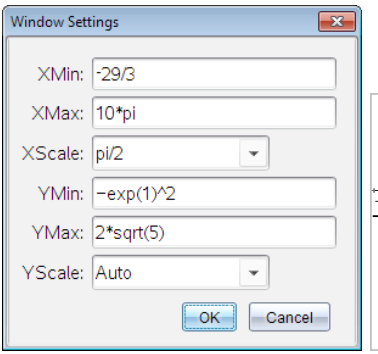
Zooming to Predefined Settings

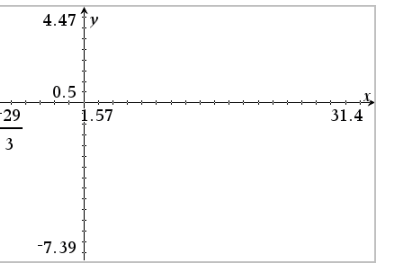
▶ From the **Window / Zoom** menu, select one of the predefined Zoom settings.

- **Zoom - Standard**
- **Zoom - Quadrant 1**
- **Zoom - Standard User**
- **Zoom - Standard Trig**
- **Zoom - Standard Data**
- **Zoom - Fit**

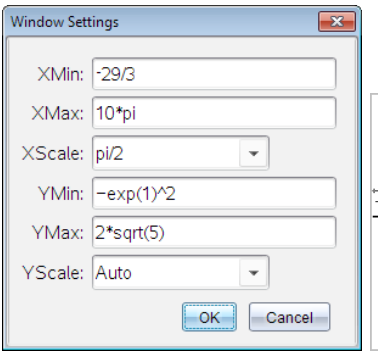
Entering Custom Window Settings

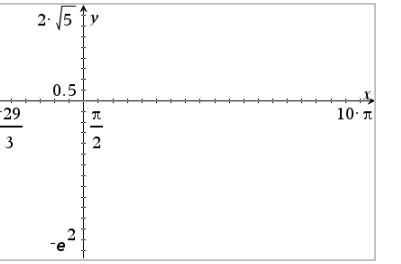
1. From the **Window / Zoom** menu, select **Window Settings**.
2. Enter a value for each setting. You can use expressions for exact input, as shown below.





On TI-Nspire™ products, fractional input is preserved as-is. Other exact inputs are replaced with the evaluated result.





On TI-Nspire™ Exact Arithmetic and CAS products, fractional and other exact inputs are preserved.

Customizing the Graphs Work Area

Inserting a Background Image

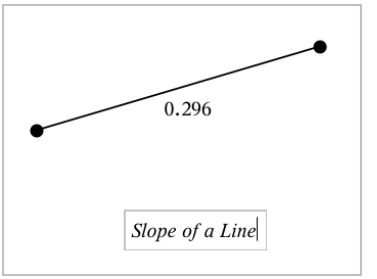
You can insert an image as a background for any Graphs or Geometry page.

1. From the **Insert** menu, click **Image**.
2. Navigate to the image you want to insert, select it, and then click **Open**.

Adding a Text Object to the Work Area

Use the Text tool to add numeric values, formulas, observations, or other explanatory information to the Graphs work area. You can graph an equation entered as text (such as "x=3").

1. From the **Actions** menu, select **Text**.
2. Click the location for the text.
3. Type the text in the box that appears, and then press **Enter**.



To move a text object, drag it. To edit the text, double-click it. To delete a text object, display its context menu, and select **Delete**.

Changing the Attributes of Numeric Text

If you enter a numeric value as text, you can lock it or set its format and displayed precision.

1. From the **Actions** menu, select **Attributes**.
2. Click the numeric text to display its list of attributes.
3. Press ▲ and ▼ to move through the list.
4. At each attribute icon, press ◄ or ► to move through the options. For example, select **0** through **9** as the precision.
5. Press **Enter** to apply the changes.
6. Press **Esc** to close the Attributes tool.

Displaying the Grid

By default, the grid is not displayed. You can choose to display it as dots or lines.

▶ From the **View** menu, select **Grid**, and then select **Dot Grid**, **Lined Grid**, or **No Grid**.

Changing the Grid Color

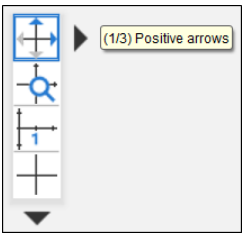
1. From the **Actions** menu, choose **Select > Grid** (available only when the grid is displayed).

   The grid flashes to show it is selected.

2. Click the down arrow next to the Color button, and select a color for the grid.

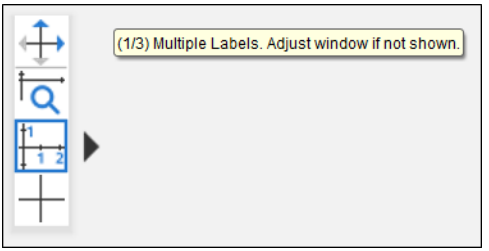
Changing the Appearance of the Graph Axes

1. From the **Actions** menu, click **Attributes**.
2. Click either axis.
3. Press ▲ and ▼ to move to the desired attribute, and then press ◄ and ► to choose the option to apply.

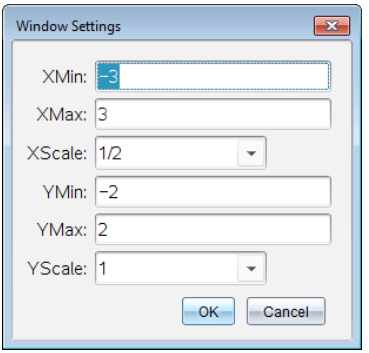


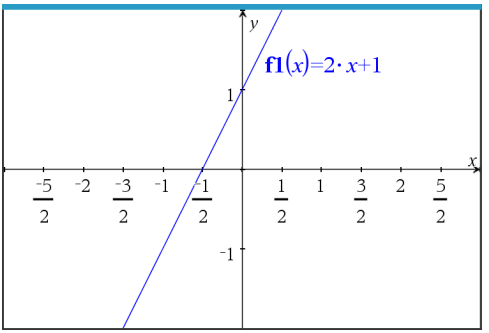
Note: To hide the axes or selectively hide or show an individual axis end-value, use the Hide/Show tool.

To display multiple tick mark labels, select the **Multiple Labels** option.

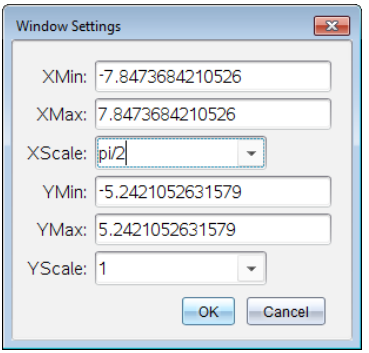


Multiple labels are only displayed if they fit both horizontally and vertically on the axes. If necessary, adjust the values in the **Window / Zoom > Window Settings** dialog.

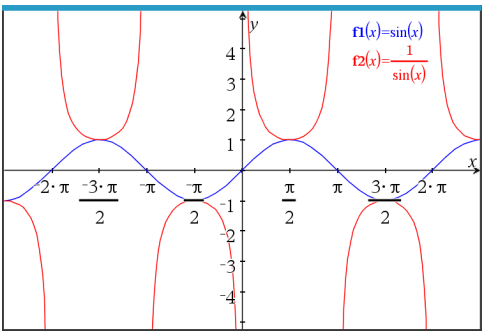




Exact Arithmetic and CAS Only: You can change the tick mark labels to display multiples of Pi, radical numbers, and other exact values by editing the **XScale** or **YScale** values in the **Window / Zoom > Window Settings** dialog. See the following example.



Note: pi/2 will be converted to π/2 after clicking **OK**.



Note: For information about path plots, see Exploring Graphs with Path Plot.

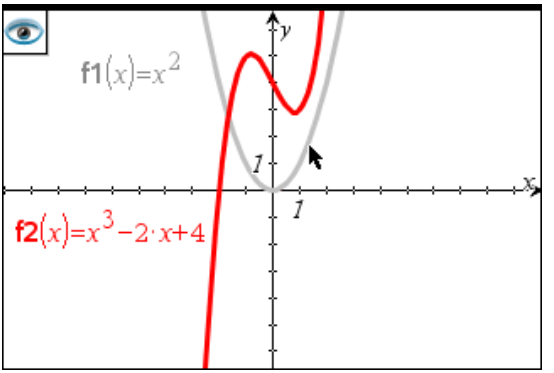
Hiding and Showing Items in the Graphs Application

The Hide/Show tool reveals objects you have previously selected as hidden and lets you select which objects to show or hide.

Note: If you hide a graph, its expression is automatically marked as hidden in the graph history.

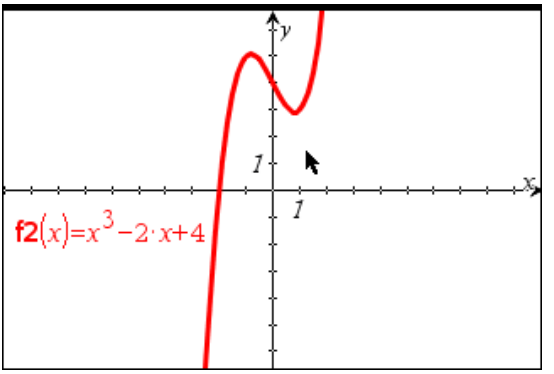
1. From the **Actions** menu, select **Hide/Show**.

   The Hide/Show tool appears at the top of the work area, and currently hidden items (if any) are shown dimmed.



2. Click objects to toggle their hide/show status. You can hide graphs, geometric objects, text, labels, measurements, and individual axis end-values.
3. Press **Esc** to complete your selections and close the tool.

   All objects you selected as hidden objects disappear.



4. To view the hidden objects temporarily or restore them as shown objects, open the Hide/Show tool.

Conditional Attributes

You can cause objects to hide, show, and change color dynamically, based on specified conditions such as "**r1<r2**" or "**sin(a1)>=cos(a2)**."

For example, you might want to hide an object based on a changing measurement that you have assigned to a variable, or you might want an object's color to change based on a "Calculate" result assigned to a variable.

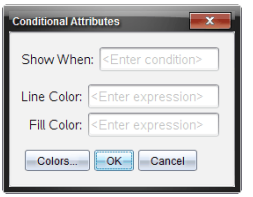
Conditional behaviors can be assigned to objects or groups in the Graphing, Plane Geometry, and 3D Graphing views.

Setting Conditional Attributes of an Object

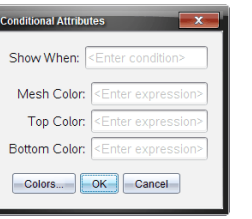
You can set conditions of a selected object either by using its context menu or by activating the Set Conditions tool from the **Actions** menu and then selecting the object. These instructions describe using the context menu.

1. Select the object or group.
2. Display the object's context menu, and click **Conditions**.

   The conditional attributes are displayed.



For 2D objects



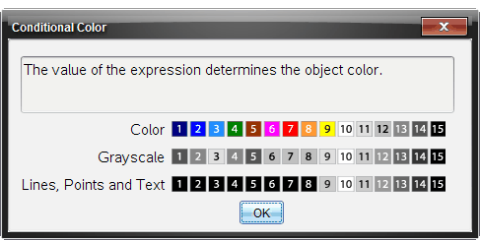
For 3D objects

3. (Optional) In the **Show When** field, enter an expression specifying the conditions during which the object will be shown. Anytime the condition is not satisfied, the object will be hidden.

   You can specify tolerance by using compound conditionals in the **Show When** input field. For example, **`area>=4 and area<=6`**.

   Note: If you need to see conditionally hidden objects temporarily, click **Actions > Hide/Show**. To return to normal viewing, press **ESC**.

4. (Optional) Enter numbers or expressions that evaluate to numbers in the applicable color fields, such as **Line Color** or **Mesh Color**. To see a map of color values, click the **Colors** button.



Map of conditional color values

5. Click **OK** in the Conditional Attributes dialog box to apply the conditions.

Calculating a Bounded Area

Note: To avoid unexpected results when using this feature, make sure the document setting for "Real or Complex Format" is set to **Real**.

When you calculate the area between curves, each curve must be:

- A function with respect to x.

  - or -

- An equation in the form y=, including y= equations defined through a text box or a conic equation template.

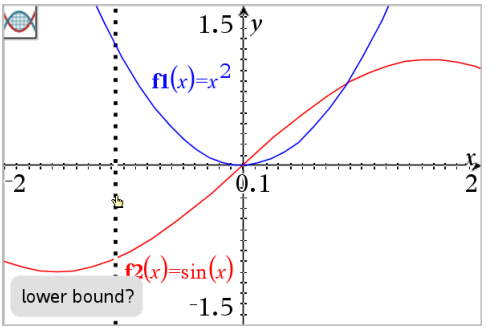
Defining and Shading the Area

1. From the **Analyze Graph** menu, select **Bounded Area**.

   If exactly two appropriate curves are available, they are selected automatically, and you can skip to step 3. Otherwise, you are prompted to select two curves.

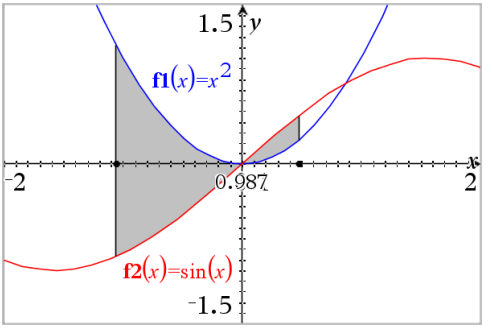
2. Click two curves to select them.
   – or –
   Click one curve and the x axis.

   You are prompted to set the lower and upper bounds.



3. Click two points to define the bounds. Optionally, you can type numeric values.

   The area becomes shaded, and the area value is displayed. The value is always non-negative, regardless of the interval direction.



Working with Shaded Areas

As you change the bounds or redefine the curves, the shading and the area value are updated .

- To change the lower or upper bound, drag it or type new coordinates for it. You cannot move a bound that resides on an intersection. However, the point moves automatically as you edit or manipulate the curves.
- To redefine a curve, either manipulate it by dragging or edit its expression in the entry line.

  If an endpoint resided originally on an intersection, and the redefined functions no longer intersect, the shading and area value disappear. If you redefine the function (s) so that there is an intersection point, the shading and area value reappear.
- To delete or hide the shaded area, or to change its color and other attributes, display its context menu.
  - Windows®: Right-click the shaded area.
  - Mac®: Hold ⌘ and click the shaded area.
  - Handheld: Move the pointer to the shaded area and press ctrl .

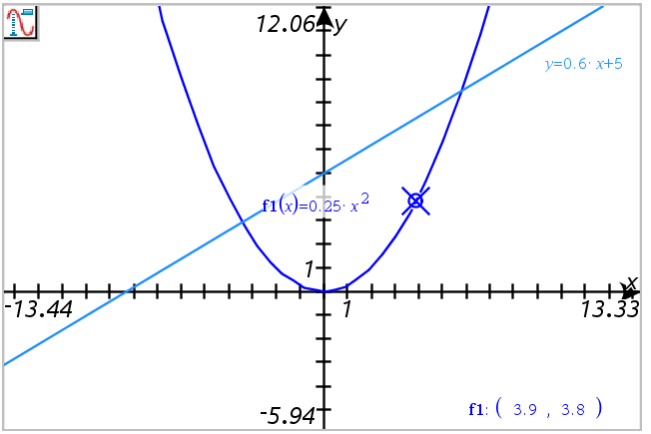
Tracing Graphs or Plots

Graph Trace lets you move a trace cursor over the points of a graph or plot and displays value information.

Tracing Specific Graphs

1. From the **Trace** menu, select **Graph Trace**.

   The Graph Trace tool appears at the top of the work area, the trace cursor appears, and the cursor coordinates are displayed in the lower right corner.



2. Explore a graph or plot:
   - Point to a position on a graph or plot to move the trace cursor to that point.
   - Press ◄ or ► to step the cursor along the current graph or plot. The screen pans automatically to keep the cursor in view.
   - Press ▲ or ▼ to cycle among the displayed graphs.
   - Click the trace cursor to create a persistent point. Optionally, enter a specific independent value to move the trace cursor to that value.
3. To stop tracing, press **Esc**.

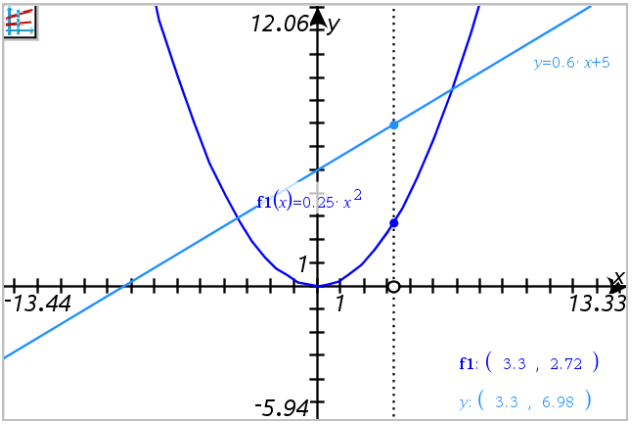
Tracing All Graphs

The Trace All tool allows tracing multiple functions simultaneously. With several functions graphed on the work area, perform the following steps:

Note: The Trace All tool traces only function graphs, not plots of other relations (polar, parametric, scatter, sequence).

1. From the **Trace** menu, select **Trace All**.

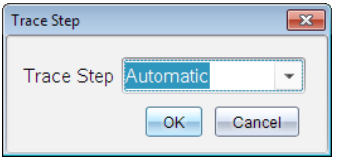
   The Trace All tool appears in the work area, a vertical line indicates the x value of the trace, and the coordinates for each traced point are displayed in the lower right corner.



2. Explore the graphs:
   - Click a point on the x axis to move all the trace points to that x value.
   - Press ◄ or ► to step the trace points along all the graphs.
3. To stop tracing, press **Esc**.

Changing the Trace Step

1. From the **Trace** menu, select **Trace Step**.



2. Choose Automatic or enter a specific step size for tracing.

Introduction to Geometric Objects

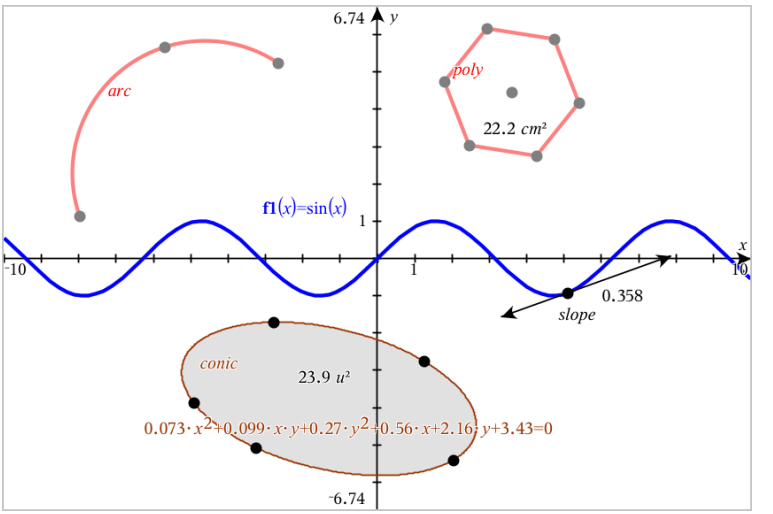
Geometry tools are accessible in both the Graphs and Geometry applications. You can use these tools to draw and investigate objects such as points, lines, and shapes.

- The Graphing view shows the Graphs work area superimposed on the Geometry work area. You can select, measure, and alter objects in both work areas.
- The Plane Geometry view shows only the objects created in the Geometry application.

Objects Created in the Graphs Application

Points, lines, and shapes created in the Graphs application are analytic objects.

- All points that define these objects reside on the x,y graph plane. Objects created here are visible only in the Graphs application. Changing the axes scale affects the appearance of the objects.
- You can display and edit the coordinates of any point on an object.
- You can display the equation of a line, tangent line, circle shape, or geometric conic created in the Graphs application.

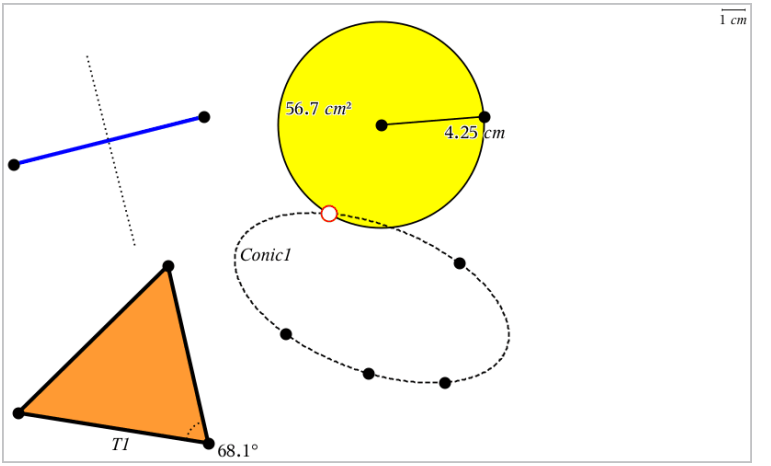


The circle arc and polygon were created in the Geometry application. The sine wave and conic were created in the Graphs application.

Objects Created in the Geometry Application

Points, lines, and shapes created in the Geometry application are not analytic objects.

- Points that define these objects do not reside on the graph plane. Objects created here are visible in both the Graphs and Geometry applications, but they are unaffected by changes to the Graphs x,y axes.
- You cannot obtain the coordinates of an object's points.
- You cannot display the equation of a geometric object created in the Geometry application



Creating Points and Lines

As you create an object, a tool appears in the work area (for example, **Segment**). To cancel, press **ESC**. To enable automatic labeling of certain objects, see *What You Must Know* in this chapter.

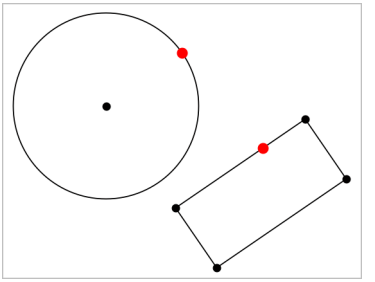
Creating a Point on the Work Area

1. From the **Points and Lines** menu, select **Point**. (In the Graphs application, click **Geometry > Points and Lines > Point**.)
2. Click a location to create the point.
3. (Optional) Label the point.
4. To move a point, drag it.

Creating a Point on a Graph or Object

You can create a point on a line, segment, ray, axis, vector, circle, graph, or axis.

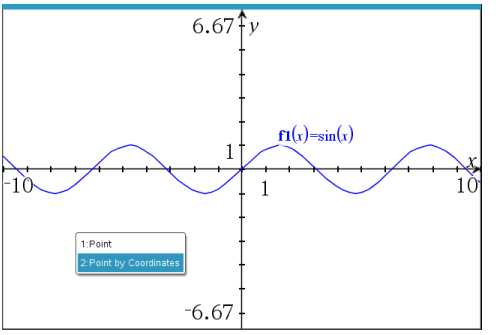
1. From the **Points and Lines** menu, select **Point On**. (In the Graphs application, click **Geometry > Points and Lines > Point On**.)
2. Click the graph or object on which you want to create the point.
3. Click a location on the object to place the point.



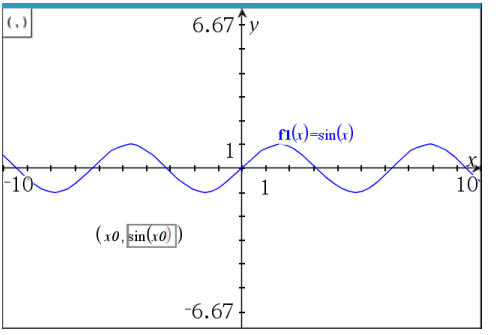
Creating a Dynamic Point on a Graph

You can create a dynamic point on a graph with Point by Coordinates.

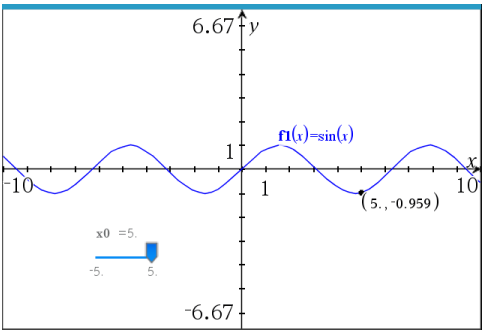
1. From the **Points and Lines** menu, select **Point by Coordinates**. (In the Graphs application, click **Geometry > Points and Lines > Point by Coordinates** or press **P** and select **Point by Coordinates**).



2. Enter the variables or expressions for one or both of the coordinates.



3. Use the slider that is created to move the point on the graph.

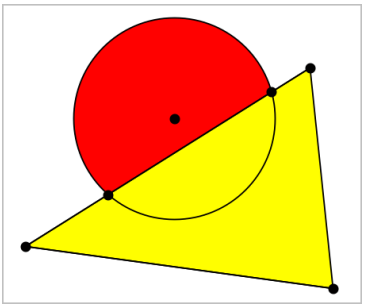


The point will display the actual coordinates. If you hover the cursor over a coordinate, it will display the variable or expression.

To edit the point, double-click the coordinate on the label. Any variable or expression that was entered before is retained.

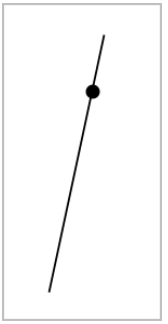
Identifying Points of Intersection

1. From the **Points and Lines** menu, select **Intersection Points**. (In the Graphs application, click **Geometry > Points and Lines > Intersection Points**.)
2. Click two intersecting objects to add points at their intersections.



Creating a Line

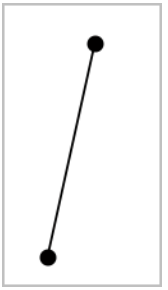
1. From the **Points and Lines** menu, select **Line**. (In the Graphs application, click **Geometry > Points and Lines > Line**.)
2. Click a location to define one point on the line.
3. Click a second location to define the direction of the line and the length of its visible portion.



4. To move a line, drag its identifying point. To rotate it, drag any point except the identifying point or ends. To extend its visible portion, drag from either end.

Creating a Segment

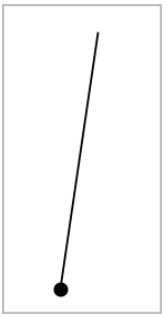
1. From the **Points and Lines** menu, select **Segment**. (In the Graphs application, click **Geometry > Points and Lines > Segment**.)
2. Click two locations to define the endpoints of the segment.



3. To move a segment, drag any point other than an endpoint. To manipulate the direction or length, drag either endpoint.

Creating a Ray

1. From the **Points and Lines** menu, select **Ray**. (In the Graphs application, click **Geometry > Points and Lines > Ray**.)
2. Click a location to define the endpoint of the ray.
3. Click a second location to define the direction.

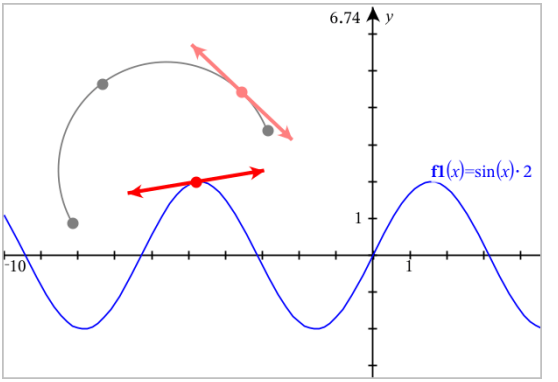


To move a ray, drag its identifying point. To rotate it, drag any point except the identifying point or end. To extend its visible portion, drag from the end.

Creating a Tangent

You can create a tangent line at a specific point on a geometric object or function graph.

1. From the **Points and Lines** menu, select **Tangent**. (In the Graphs application, click **Geometry > Points and Lines > Tangent**.)
2. Click the object to select it.
3. Click a location on the object to create the tangent.

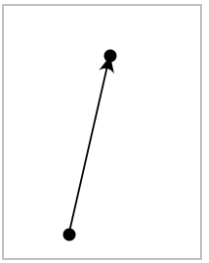


4. To move a tangent, drag it. It remains attached to the object or graph.

Creating a Vector

1. From the **Points and Lines** menu, select **Vector**. (In the Graphs application, click **Geometry > Points and Lines > Vector**.)

2. Click a location to establish the vector's initial point.
3. Click a second location to specify direction and magnitude and complete the vector.

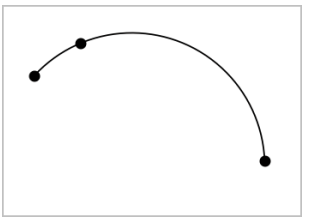


4. To move a vector, drag any point other than the endpoints. To manipulate the magnitude and/or direction, drag either end point.

   Note: If you create an endpoint on an axis or another object, you can move the endpoint only along that object.

Creating a Circle Arc

1. From the **Points and Lines** menu, select **Circle Arc**. (In the Graphs application, click **Geometry > Points and Lines > Circle Arc**.)
2. Click a location or point to establish the starting point of the arc.
3. Click a second point to establish an intermediate point through which the arc will pass.
4. Click a third point to set the ending point and complete the arc.



5. To move an arc, drag its perimeter. To manipulate it, drag any of its three defining points.

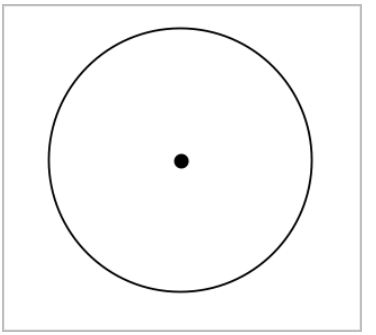
Creating Geometric Shapes

The Shape tools let you explore circles, polygons, conics, and other geometric objects.

As you create a shape, a tool appears in the work area (for example, **Circle**). To cancel the shape, press **ESC**. To enable automatic labeling of certain objects, see *What You Must Know*, in this chapter.

Creating a Circle

1. From the **Shapes** menu, select **Circle**. (In the Graphs application, click **Geometry > Shapes > Circle**.)
2. Click a location or point to position the circle's center point.
3. Click a location or point to establish the radius and complete the circle.

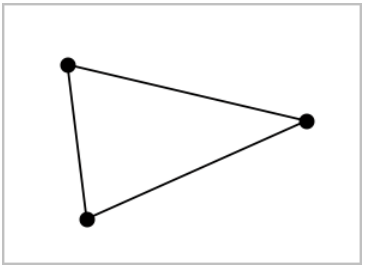


4. To resize a circle, drag its perimeter. To move it, drag its center point.

Creating a Triangle

Note: To ensure that the sum of the angles of a triangle equals 180° or 200 gradians, you can force integer angles in the Geometry view. Refer to *What You Must Know*, in this chapter.

1. From the **Shapes** menu, select **Triangle**. (In the Graphs application, click **Geometry > Shapes > Triangle**.)
2. Click three locations to establish the vertices of the triangle.

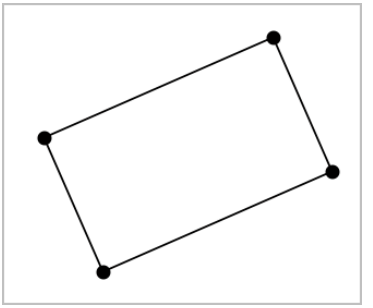


3. To manipulate a triangle, drag any point. To move it, drag any side.

Creating a Rectangle

1. From the **Shapes** menu, select **Rectangle**. (In the Graphs application, click **Geometry > Shapes > Rectangle**.)
2. Click a location or point to establish the first corner of the rectangle.
3. Click a location for the second corner.

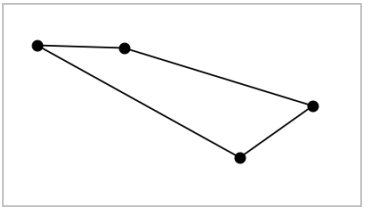
   One side of the rectangle is displayed.
4. Click to establish the distance to the opposite side and complete the rectangle.



5. To rotate a rectangle, drag one of its first two points. To extend it, drag one of the last two points. To move it, drag any side.

Creating a Polygon

1. From the **Shapes** menu, select **Polygon**. (In the Graphs application, click **Geometry > Shapes > Polygon**.)
2. Click a location or point to establish the first vertex of the polygon.
3. Click to establish each additional vertex.
4. To complete the polygon, click the first vertex.

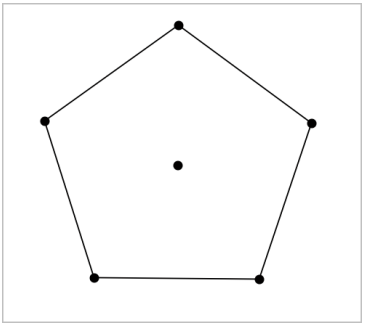


5. To manipulate a polygon, drag any vertex. To move it, drag any side.

Creating a Regular Polygon

1. From the **Shapes** menu, select **Regular Polygon**. (In the Graphs application, click **Geometry > Shapes > Regular Polygon**.)
2. Click once on the work area to establish the center point.
3. Click a second location to establish the first vertex and radius.

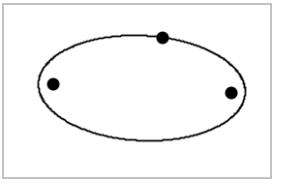
   A 16-sided regular polygon is formed. The number of sides is displayed in brackets; for example, {16}.
4. Drag any vertex in a circular motion to set the number of sides.
   - Drag clockwise to reduce the number of sides.
   - Drag counterclockwise to add diagonals.



5. To resize or rotate a regular polygon, drag any of its points. To move it, drag any side.

Creating an Ellipse

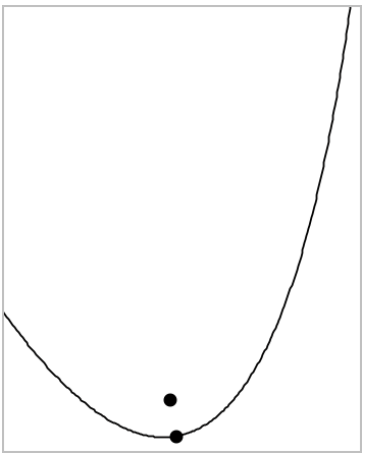
1. From the **Shapes** menu, select **Ellipse**. (In the Graphs application, click **Geometry > Shapes > Ellipse**.)
2. Click two locations or points to establish the foci.
3. Click to establish a point on the ellipse and complete the shape.



4. To manipulate an ellipse, drag any of its three defining points. To move it, drag its perimeter.

Creating a Parabola (from focus and vertex)

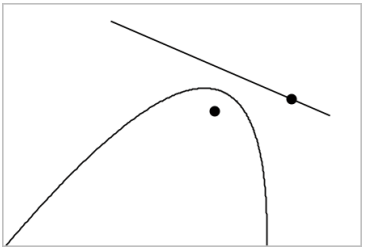
1. From the **Shapes** menu, select **Parabola**. (In the Graphs application, click **Geometry > Shapes > Parabola**.)
2. Click a location to establish the focus.
3. Click a location to establish the vertex and complete the parabola.



4. To manipulate a parabola, drag its focus or its vertex. To move it, drag it from any other point.

Creating a Parabola (from focus and directrix)

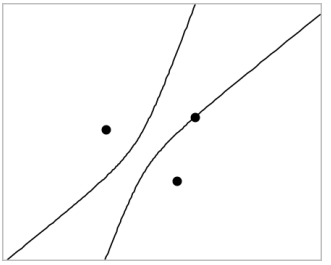
1. Create a line to serve as the directrix.
2. From the **Shapes** menu, select **Parabola**. (In the Graphs application, click **Geometry > Shapes > Parabola**.)
3. Click a location to establish the focus.
4. Click the line to establish it as the directrix.



5. To manipulate a parabola, rotate or move its directrix or drag its focus. To move it, select both the directrix and the focus, and then drag either object.

Creating a Hyperbola

1. From the **Shapes** menu, select **Hyperbola**. (In the Graphs application, click **Geometry > Shapes > Hyperbola**.)
2. Click two locations to establish the foci.
3. Click a third location to complete the hyperbola.

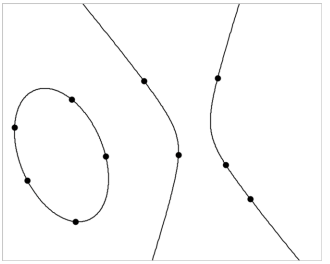


4. To manipulate a hyperbola, drag any of its three defining points. To move it, drag it from any other place on the shape.

Creating a Conic by Five Points

1. From the **Shapes** menu, select **Conic by Five Points**. (In the Graphs application, click **Geometry > Shapes > Conic by Five Points**.)
2. Click five locations to establish the five points on the shape.

   Depending on the pattern of the points, the conic can be a hyperbola or an ellipse.



3. To manipulate a conic, drag any of its five defining points. To move it, drag it from any other place on the shape.

Creating Shapes Using Gestures (MathDraw)

The MathDraw tool lets you use touchscreen or mouse gestures to create points, lines, circles, and other shapes.

MathDraw is available in:

- Geometry view without the analytic window displayed.
- Graphing view when the x scale and y scale are identical. This avoids non-circular ellipses and non-square rectangles appearing as circles and squares.

MathDraw is not available in the 3D Graphing view or in the Geometry view with the analytic window displayed.

Activating MathDraw

1. If using the Geometry view with the analytic window visible, use the **View** menu to hide the window.
2. On the **Actions** menu, select **MathDraw**.

   The MathDraw icon appears. You can begin using the tool.

Canceling MathDraw

▶ When you have finished using the MathDraw tool, press **Esc**.

The tool also closes if you select a different tool or change views.

Creating Points

To create a labeled point, tap or click in an open area.

- If the point is close to an existing line, segment, ray, geometric conic (including circles), or polygon, the point snaps to that object. You can also place a point on the intersection of any two of those types of objects.

- If the point is close to a visible grid location in a Graphs view or the analytic window of a Geometry view, it snaps to the grid.

Drawing Lines and Segments

To create a line or segment, touch or click the initial position, and then drag to the end position.

- If the drawn line passes near an existing point, the line snaps to the point.
- If the drawn line starts close to an existing point and ends next to another existing point , it becomes a segment defined by those points.
- If the drawn line is nearly parallel or perpendicular to an existing line, segment, or side of a polygon, it aligns to that object.

  Note: The default tolerance for detecting parallel/perpendicular lines is 12.5 degrees. This tolerance can be redefined using a variable named **ti_gg_fd.angle_tol**. You can change the tolerance in the current problem by setting this variable in the calculator app to a value in the range 0 through 45 (0=no parallel/perpendicular detection).

Drawing Circles and Ellipses

To create a circle or ellipse, use the touchscreen or mouse to draw the approximate shape.

- If the drawn shape is sufficiently circular, a circle is created.
- If the shape is elongated, an ellipse is created.
- If the virtual center of the drawn shape is near an existing point, the circle or ellipse is centered on that point.

Drawing Triangles

To create a triangle, draw a triangle-like shape.

- If a drawn vertex is close to an existing point, the vertex snaps to the point.

Drawing Rectangles and Squares

To create a rectangle or square, use the touchscreen or mouse to draw the perimeter.

- If the drawn shape is nearly square, a square is created.
- If the drawn shape is elongated, a rectangle is created.
- If the center of a square is close to an existing point, the square snaps to that point.

Drawing Polygons

To create a polygon, tap or click a succession of existing points, ending on the first point you tapped.

Using MathDraw to Create Equations

In the Graphs view, MathDraw attempts to recognize certain gestures as functions for analytic parabolas.

Note: The default step value for quantization of the parabola coefficients is 1/32. The denominator of this fraction can be redefined using a variable named **ti_gg_fd.par_quant**. You can change the step value in the current problem by setting this variable to a value greater or equal to 2. A value of 2, for example, produces a step value of 0.5.

Using MathDraw to Measure an Angle

To measure the angle between two existing lines, use the touchscreen or mouse to draw a circle arc from one of the lines to the other.

- If the intersection point between the two lines does not exist, it is created and labeled.
- The angle is not a directed angle.

Using MathDraw to Find a Mid-point

To create a point midway between two points, tap or click point 1, point 2, and then point 1 again.

Using MathDraw to Erase

To erase objects, use the touchscreen or mouse to drag left and right, similar to the motion of erasing a whiteboard.

- The erasure area is the bounding rectangle of the erasure gesture.
- All point objects and their dependents inside the erasure area are removed.

Basics of Working with Objects

Selecting and Deselecting Objects

You can select an individual object or multiple objects. Select multiple objects when you want to quickly move, color, or delete them together.

1. Click an object or graph to select it.

The object flashes to indicate selection.

2. Click any additional objects to add them to the selection.
3. Perform the operation (such as moving or setting color).
4. To deselect all objects, click an empty space in the work area.

Grouping and Ungrouping Geometric Objects

Grouping objects gives you a way to reselect them as a set, even after you have deselected them to work with other objects.

1. Click each object to add it to the current selection.

   The selected objects flash.

2. Display a context menu of the selected object or objects.
3. Click **Group**. You can now select all the items in the group by clicking any of its members.
4. To split a group into individual objects, display a context menu of any of its member objects, and click **Ungroup**.

Deleting Objects

1. Display the context menu of the object or objects.
2. Click **Delete**.

   You cannot delete the origin, the axes, or points representing locked variables, even if those items are included in the selection.

Moving Objects

You can move an object, group, or combination of selected objects and groups.

Note: If an immovable object (such as the graph axes or a point with locked coordinates) is included in a selection or group, you cannot move any of the objects. You must cancel the selection and then select only movable items.

To move this...	Drag this
A multiple-object selection or group	Any of its objects

To move this...	Drag this
A point	The point
A segment or vector	Any point other than an endpoint
A line or ray	The identifying point
A circle	The center point
Other geometric shapes	Any position on the object except one of its defining points. For example, move a polygon by dragging any of its sides.

Constraining Object Movement

Holding down the **SHIFT** key before dragging lets you constrain how certain objects are drawn, moved, or manipulated.

Use the constraint feature to:

- Rescale only a single axis in the Graphs application.
- Pan the work area horizontally or vertically, depending on which direction you drag initially.
- Limit object movement to horizontal or vertical.
- Limit point placement to 15° increments as you draw a triangle, rectangle, or polygon.
- Limit angle manipulations to 15° increments.
- Limit the radius of a resized circle to integer values.

Pinning Objects

Pinning objects prevents accidental changes as you move or manipulate other objects.

You can pin graphed functions, geometric objects, text objects, the graph axes, and the background.

1. Select the object or objects to pin, or click an empty area if you are pinning the background.
2. Display the context menu, and select **Pin**.

   A pinned object displays a pin icon when you point to it.

3. To unpin an object, display its context menu, and select **Unpin**.

Notes:

- Although you cannot drag a pinned point, you can reposition it by editing its x and y coordinates.
- You cannot pan the work area while the background is pinned.

Changing the Line or Fill Color of an Object

Color changes made in the software are displayed in shades of gray when you work on documents using a TI-Nspire™ CX handheld that does not support color. Color is preserved when you move documents back to the software.

1. Select the object or objects.
2. Display the object's context menu, click **Color**, and then click **Line Color** or **Fill Color**.
3. Select the color to apply to the objects.

Changing the Appearance of an Object

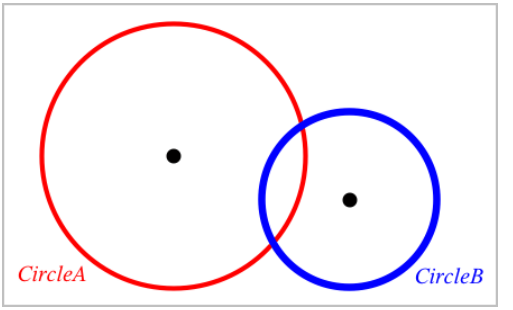
1. From the **Actions** menu, select **Attributes**.
2. Click the object that you want to change. You can change shapes, lines, graphs, or graph axes.

   The list of the attributes for the selected object are displayed.
3. Press ▲ and ▼ to move through the list of attributes.
4. At each attribute icon, press ◄ or ► to move through the options. For example, select Thick, Thin, or Medium for the Line Weight attribute.
5. Press **Enter** to apply the changes.
6. Press **ESC** to close the Attributes tool.

Labeling Points, Geometric Lines, and Shapes

1. Display the context menu of the object.
2. Click **Label**.
3. Type the text of the label, and then press **Enter**.

   The label attaches itself to the object and follows the object as you move it. The label's color matches the object's color.



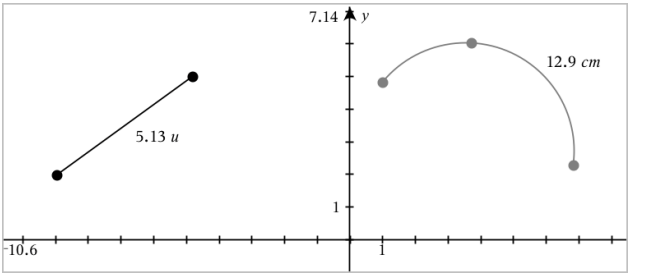
Measuring Objects

Measurement values update automatically as you manipulate the measured object.

Note: Measurements of objects created in the Graphs application are displayed in generic units named *u*. Measurements of objects created in the Geometry application are displayed in centimeters (*cm*).

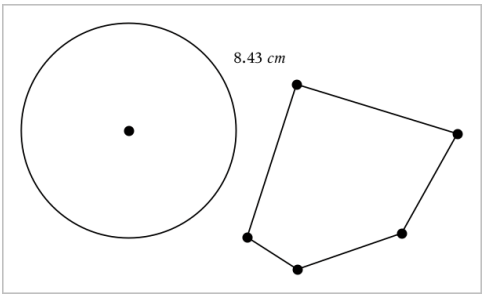
Measuring Length of a Segment, Circle Arc, or Vector

1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click the object to display its length.



Measuring Distance Between Two Points, a Point and a Line, or a Point and a Circle

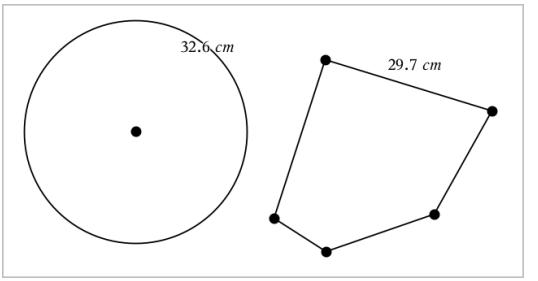
1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click the first point.
3. Click the second point or a point on the line or circle.



In this example, length is measured from the center of the circle to the upper left vertex of the polygon.

Measuring Circumference of a Circle or Ellipse or the Perimeter of a Polygon, Rectangle, or Triangle

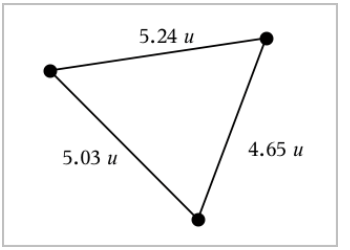
1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click the object to display its circumference or perimeter.



Measuring a Side of a Triangle, Rectangle, or Polygon

1. From the **Measurement** menu, select **Length**. (In the Graphs application, click **Geometry > Measurement > Length**.)
2. Click two points on the object that form the side you want to measure.

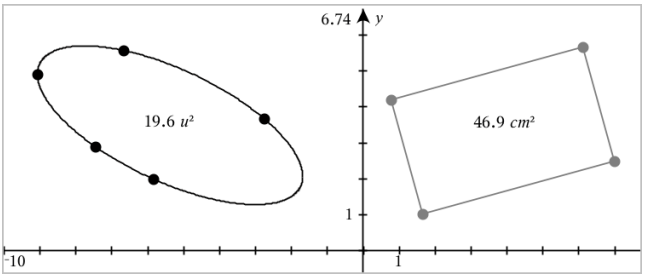
   Note: You must click *two points* to measure a side. Clicking the side measures the entire length of the object's perimeter.



Measuring Area of a Circle, Ellipse, Polygon, Rectangle, or Triangle

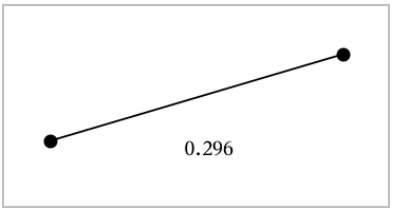
Note: You cannot measure the area of a polygon constructed using the Segment tool.

1. From the **Measurement** menu, select **Area**. (In the Graphs application, click **Geometry > Measurement > Area**.)
2. Click the object to display its area.



Measuring Slope of a Line, Ray, Segment, or Vector

1. From the **Measurement** menu, select **Slope**. (In the Graphs application, click **Geometry > Measurement > Slope**.)
2. Click the object to display its slope.

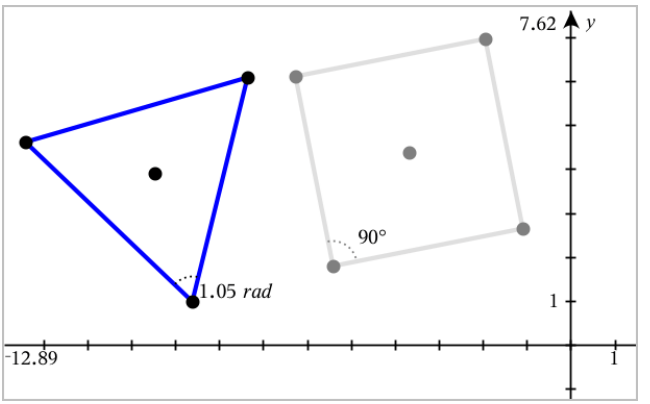


The value is updated automatically when you manipulate the object.

Measuring Angles

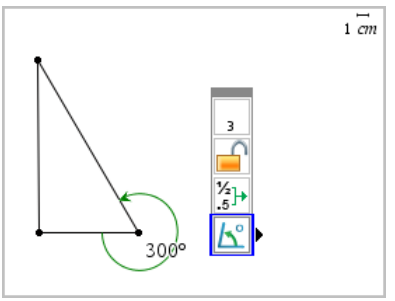
Measured angles in the Geometry application range from 0° to 180°. Measured angles in the Graphs application range from 0 radians to π radians. To change the angle unit, use the **Settings** menu.

1. From the **Measurement** menu, select **Angle**. (In the Graphs application, click **Geometry > Measurement > Angle**.)
2. Click three locations or points to define the angle. The second click defines the vertex.



Measuring Angles using the Directed Angle Tool

1. From the **Measurement** menu, select **Directed Angle**. (In the Graphs application, click **Geometry > Measurement > Directed Angle**.)
2. Click three locations or existing points to define the angle. The second click defines the vertex.



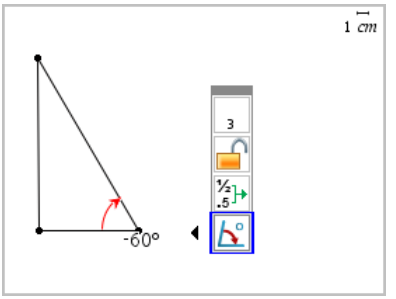
3. To reverse the measurement orientation,

a) On the **Actions** menu, select **Attributes**.

b) Click the angle text. For example, click **300**°.

c) Select the orientation attribute, and use the right or left arrow key to change it.

d) Press **Esc** to close the Attributes tool.



Moving a Measured Value

▶ Drag the measurement to the desired location.

Note: If you move a measurement too far from its object, it stops following the object. However, its value continues to be updated as you manipulate the object.

Editing a Measured Length

You can set the length of a side of a Triangle, Rectangle, or Polygon by editing its measured value.

▶ Double-click the measurement, and then enter the new value.

Storing a Measured Value as a Variable

Use this method to create a variable and assign a measured value to it.

1. Display the item's context menu, and select **Store**.
2. Type a variable name for the stored measurement.

Linking a Measured Length to an Existing Variable

Use this method to assign a measured length value to an existing variable.

1. Display the measurement's context menu, and select **Variables > Link to**.

   The menu shows the list of currently defined variables.

2. Click the name of the variable you want to link to.

Deleting a Measurement

▶ Display the measurement's context menu, and select **Delete**.

Locking or Unlocking a Measurement

1. Display the measurement's context menu, and select **Attributes**.
2. Use the up/down arrow keys to highlight the Lock attribute.
3. Use the left/right arrow keys to close or open the lock.

   As long as the value remains locked, manipulations are not allowed that would require the measurement to change.

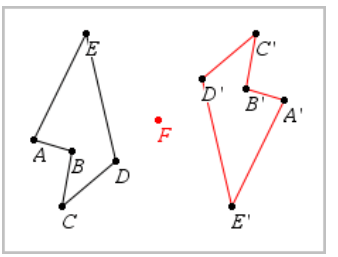
Transforming Objects

You can apply transformations to drawn objects in both the Graphs and Geometry applications. If the object's points are labeled, the corresponding points in the transformed object are labeled using prime notation ($A \rightarrow A'$). To enable automatic labeling of certain objects, see *What You Must Know* in this chapter.

Exploring Symmetry

1. From the **Transformation** menu, select **Symmetry**. (In the Graphs application, click **Geometry > Transformation > Symmetry**.)
2. Click the object whose symmetry you want to explore.
3. Click a location or existing point to establish the point of symmetry.

   A symmetrical image of the object is displayed.



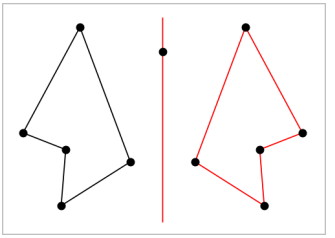
4. Manipulate the original object or the point of symmetry to explore the symmetry.

Exploring Reflection

1. Create a line or segment to predefine the line about which the object will be reflected.

2. From the **Transformation** menu, select **Reflection**. (In the Graphs application, click **Geometry > Transformation > Reflection**.)
3. Click the object whose reflection you want to explore.
4. Click the predefined reflection line or segment.

   A reflected image of the object is displayed.

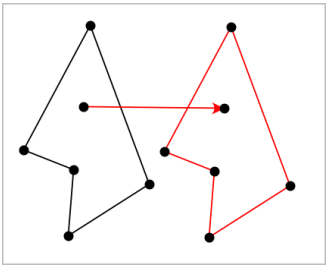


5. Manipulate the original object or the line of symmetry to explore the reflection.

Exploring Translation

1. (Optional) Create a vector to predefine the distance and direction of translation.
2. From the **Transformation** menu, select **Translation**. (In the Graphs application, click **Geometry > Transformation > Translation**.)
3. Click the object whose translation you want to explore.
4. Click the predefined vector.
   —or—
   Click two locations on the work area to indicate the direction and distance of translation.

   A translated image of the object is displayed.

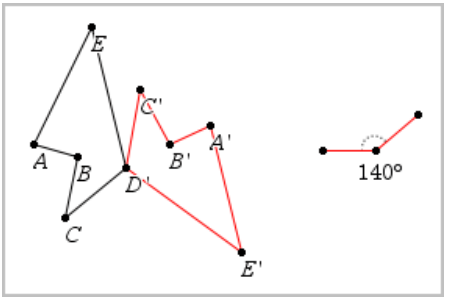


5. Manipulate the original object or the vector to explore the translation.

Exploring Rotation

1. (Optional) Create an angle measurement to serve as a predefined angle of rotation.
2. From the **Transformation** menu, select **Rotation**. (In the Graphs application, click **Geometry > Transformation > Rotation**.)
3. Click the object whose rotation you want to explore.
4. Click a location or point to define the point of rotation.
5. Click the points of the predefined angle.
   —or—
   Click three locations to define an angle of rotation.

   A rotated image of the object is displayed.



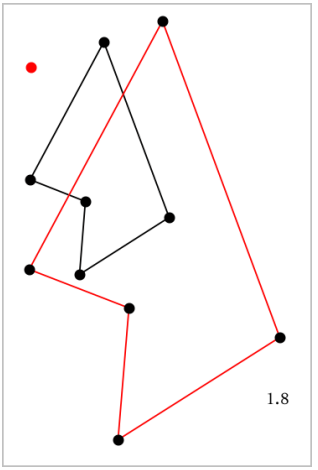
6. Manipulate the original object or the point of rotation to explore the rotation.

Exploring Dilation

1. Create a Text object containing a numeric value to serve as a predefined dilation factor.

   Note: You can also use a measured length value as the dilation factor. Keep in mind that if you use a large value, you may have to pan the display to view the dilated object.
2. From the **Transformation** menu, select **Dilation**. (In the Graphs application, click **Geometry > Transformation > Dilation**.)
3. Click the object whose dilation you want to explore.
4. Click a location or existing point to define the center point of dilation.
5. Click the Text object or measurement that defines the dilation factor.

   A dilated image of the object is displayed.



6. Manipulate the original object or the center point of dilation to explore the dilation. You can also edit the dilation factor.

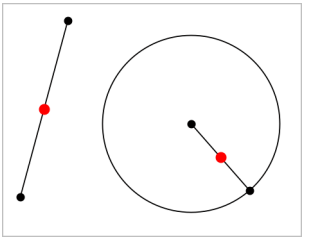
Exploring with Geometric Construction Tools

While a construction is in progress, a tool appears in the work area (for example, **Parallel**). To cancel, press **ESC**.

Creating a Midpoint

This tool lets you bisect a segment or define a midpoint between any two points. The points can be on a single object, on separate objects, or on the work area.

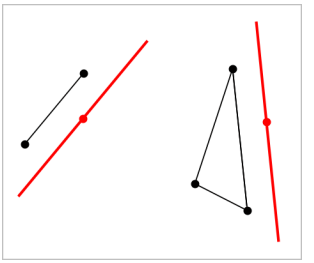
1. From the **Construction** menu, select **Midpoint**. (In the Graphs application, click **Geometry > Construction > Midpoint**.)
2. Click a point or location to define the first point.
3. Click a second point or location to complete the midpoint.



Creating a Parallel Line

This tool creates a parallel line with respect to any existing line. The existing line can be a Graphs axis or any side of a triangle, square, rectangle, or polygon.

1. From the **Construction** menu, select **Parallel**. (In the Graphs application, click **Geometry > Construction > Parallel**.)
2. Click the object that will serve as the reference line.
3. Click a location to create the parallel line.

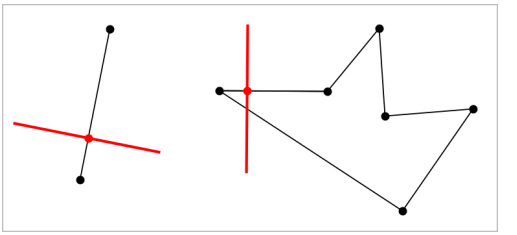


You can drag the parallel line to move it. If you manipulate the reference object, the line remains parallel.

Creating a Perpendicular Line

You can create a line that is perpendicular to a reference line. The reference can be an axis, an existing line, a segment, or one side of a triangle, rectangle, or polygon.

1. From the **Construction** menu, select **Perpendicular**. (In the Graphs application, click **Geometry > Construction > Perpendicular**.)
2. Click a location or existing point through which the perpendicular line should pass.
3. Click the item that will serve as the reference line.

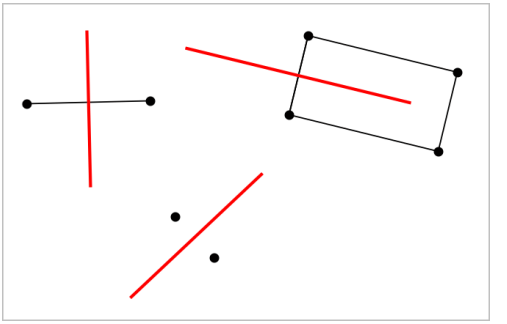


You can drag the intersection point to move the perpendicular. If you manipulate the reference object, the line remains perpendicular.

Creating a Perpendicular Bisector

You can create a perpendicular bisector on a segment, on one side of a triangle, rectangle, or polygon, or between any two points.

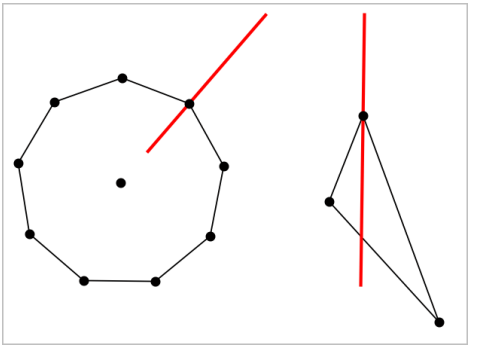
1. From the **Construction** menu, select **Perpendicular Bisector**. (In the Graphs application, click **Geometry > Construction > Perpendicular Bisector**.)
2. Click the item that will serve as the reference line.
   —or—
   Click two points to create a perpendicular bisector between them.



Bisecting an Angle

This tool creates an angle bisector. The points of the angle can be on existing objects, or they can be locations on the work area.

1. From the **Construction** menu, select **Angle Bisector**. (In the Graphs application, click **Geometry > Construction > Angle Bisector**.)
2. Click three locations or points to define the angle. The second click defines the vertex of the angle.

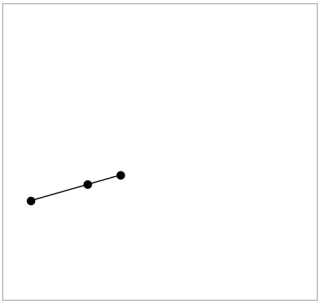


The angle bisector adjusts automatically as you manipulate its defining points.

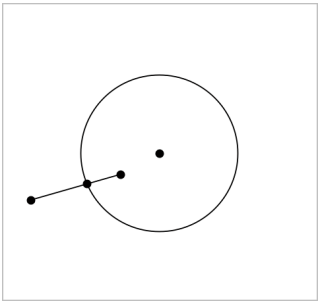
Creating a Locus

The Locus tool enables you to explore the range of motion of one object with respect to another object as constrained by a shared point.

1. Create a segment, line, or circle.
2. Create a point on the segment, line, or circle.



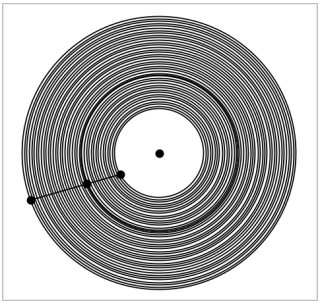
3. Create another object that uses the point created in the previous step.



Circle created to use the defined point on the segment.

4. From the **Construction** menu, select **Locus**. (In the Graphs application, click **Geometry > Construction > Locus**.)
5. Click the point shared by the objects.
6. Click the object defined to share the point (this is the object to vary).

The continuous locus is displayed.

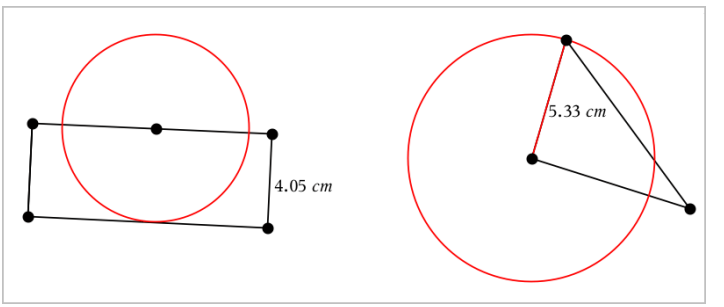


Creating a Compass

This tool operates similarly to a geometric compass used for drawing circles on paper.

1. From the **Construction** menu, select **Compass**. (In the Graphs application, click **Geometry > Construction > Compass**.)
2. To set the width (radius) of the compass:

   Click a segment.
   —or—
   Click any side of a triangle, rectangle, polygon, or regular polygon.
   —or—
   Click any two existing points or locations on the work area.
3. Click a location to establish the center of the circle and complete the construction.



   The radius adjusts automatically as you manipulate the original segment, side, or points used to define the radius.

Animating Points on Objects

You can animate any point created as a point on an object or graph. Multiple points can be animated simultaneously.

Animating a Point

1. From the **Actions** menu, select **Attributes**.
2. Click the point to display its attributes.
3. Press ▼ to select the animation attributes.
4. Press ◄ or ► to choose either unidirectional or alternating animation.
5. Type a value to set the animation speed. Any nonzero speed begins the animation. To reverse the direction, enter a negative value.
6. Press **Enter** to display the animation controls ⏮ ⏸.
7. Press **ESC** to close the Attributes tool.

Pausing and Resuming All Animations

► To pause all animations on a page, click **Pause** ⏸.

► To resume all animations, click **Play** ▶.

Resetting All Animations

Resetting pauses all animations and returns all animated points to the positions they occupied when they were first animated.

► To reset animation, click **Reset** ⏮.

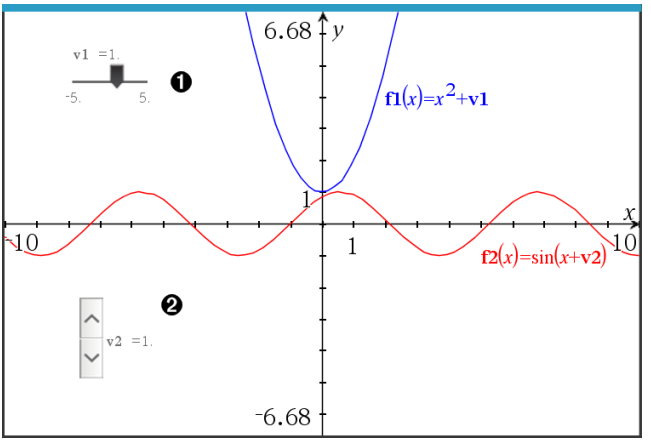
Changing or Stopping the Animation of a Point

1. Click **Reset** ⏮ to stop all animation.
2. From the **Actions** menu, select **Attributes**.
3. Click the point to display its attributes.
4. Select the animation attribute, and type a new animation speed. To stop the point's animation, enter zero.

   Note: If other animated points exist, the animation controls remain in the work area.

Adjusting Variable Values with a Slider

A slider control lets you interactively adjust or animate the value of a numeric variable. You can insert sliders in the Graphs, Geometry, Notes, and Data & Statistics applications.



❶ Horizontal slider for adjusting variable *v1*.

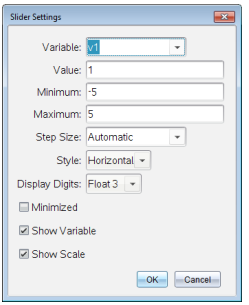
❷ Minimized vertical slider for adjusting variable *v2*.

Note: TI-Nspire™ version 4.2 or higher is required for opening .tns files containing sliders on Notes pages.

Inserting a Slider Manually

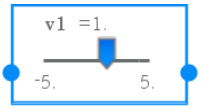
1. From a Graphs, Geometry, or Data & Statistics page, select **Actions > Insert Slider**.
   —or—
   From a Notes page, make sure the cursor is not in a math box or chem box, and then select **Insert > Insert Slider**.

   The Slider Settings screen opens.



2. Enter the desired values, and click **OK**.

   The slider is displayed. On a Graphs, Geometry, or Data & Statistics page, handles are displayed to let you move or stretch the slider.



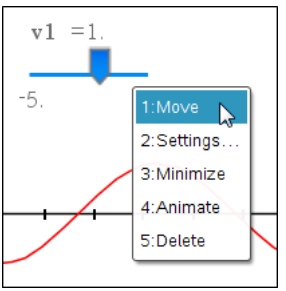
To remove the handles and use the slider, click an empty space in the work area. You can show the handles anytime by selecting **Move** from the slider's context menu.

3. To adjust the variable, slide the pointer (or click the arrows on a minimized slider).
   - You can use the **Tab** key to move the focus to a slider or to move from one slider to the next. The color of the slider changes to show you when it has the focus.
   - When a slider has the focus, you can use the arrow keys to change the value of the variable.

Working with the Slider

Use the options on the context menu to move or delete the slider, and to start or stop its animation. You can also change the slider's settings.

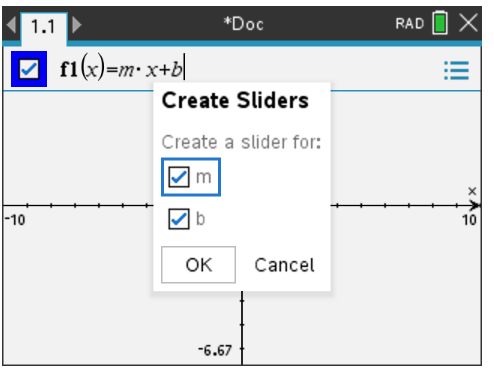
1. Display the slider's context menu.



2. Click an option to select it.

Automatic Sliders in Graphs

Sliders can be created for you automatically in the Graphs application and in the analytic window of the Geometry application. You are offered automatic sliders when you define certain functions, equations, or sequences that refer to undefined variables.



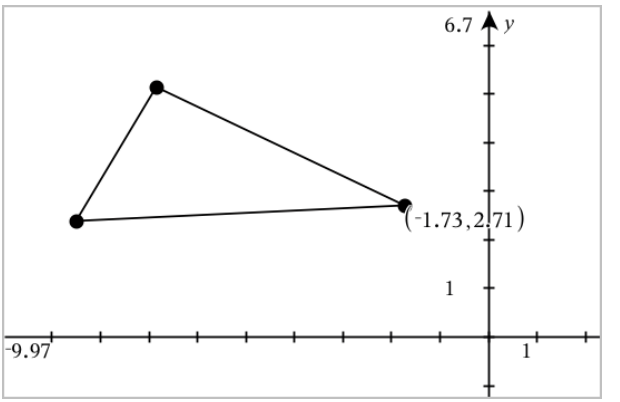
Labeling (Identifying) the Coordinates of a Point

The Graphs application can identify and label the coordinates of any existing point, provided the point was created in the Graphs application.

1. From the **Actions** menu, select **Coordinates and Equations**.

   The tool appears at the top of the work area

2. Tap the point whose coordinates you want to show.



3. Press **Esc** to close the tool.

If you later move the point to a different location, the coordinates follow the point and update automatically.

Displaying the Equation of a Geometric Object

You can display the equation of a line, tangent line, circle shape, or geometric conic, provided the object was constructed in the Graphing View or within the Analytic Window of the Plane Geometry View.

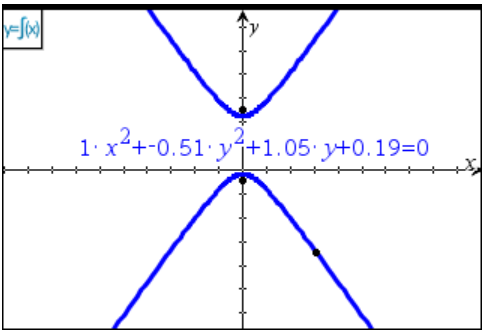
Note: Due to differences in the numerical representations of analytic and geometric conics, the capability to convert a geometric conic to an analytic template may sometimes be unavailable. This is done in order to avoid a situation where the template-based conic would be different from the geometric one.

1. From the **Actions** menu, click **Coordinates and Equations.**
2. Move the pointer to the object.

   The equation for the object appears.

   Note: If you approach a defined point on the line or the center point of a circle, the coordinates of that point are displayed instead of the equation. Move the pointer away from the defined point to obtain the equation of the object.

3. Click to attach the equation to the pointer.
4. Move the equation to the desired location, and click to anchor it.



5. Press **Esc** to exit the tool.

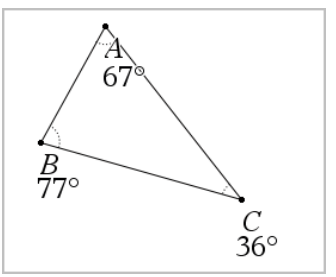
Using the Calculate Tool

The Calculate tool is available in the Graphs and Geometry applications. It lets you evaluate a math expression you have entered as a text object.

The following example uses the Calculate tool to sum the measured angles of a triangle.

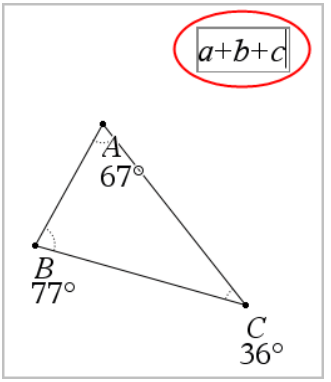
1. Using the **Shapes** menu, create a triangle, and then measure its angles.

   Tip: You can enable options to automatically label points and to force geometric triangle angles to integers. For more information, see *What You Must Know*, in this chapter.



2. From the **Actions** menu, click **Text**.
3. Click a location for the text, and type the formula for the calculation.

   In this example, the formula sums three terms.



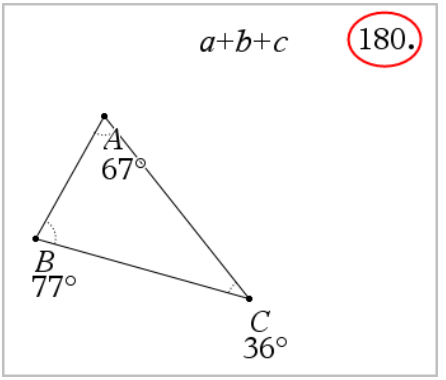
4. From the **Actions** menu, click **Calculate**.
5. Click the formula you created.

   You are prompted to select a value for each term in the formula.

6. Click each angle measurement when prompted.

   Note: If you have stored a measurement as a variable, you can select it when prompted by clicking var. If the name of a stored measurement matches a term in the formula, you can press "L" when prompted for that term.

   After you have selected the third term, the calculation result attaches itself to the pointer.



7. Position the result, and press **Enter** to anchor it as a new text object.

3D Graphs

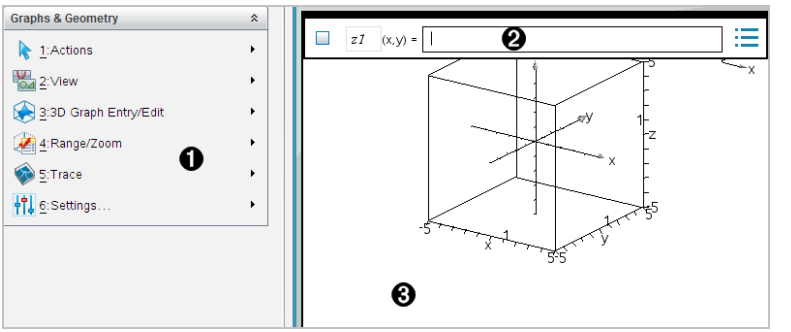
The 3D Graphing view lets you create and explore three-dimensional graphs of:

- 3D functions of the form z(x,y)
- 3D parametric plots

Selecting the 3D Graphing View

The 3D Graphing View is available on any Graphs page or Geometry page .

▶ From the **View** menu, select **3D Graphing**.



❶ **3D Graphs Menu**

❷ **Entry line**. Lets you define 3D graphs. The default graph type is 3D Function, indicated by $z1(x,y)=$.

❸ **3D Graphs Work Area.** Shows a 3D box containing graphs that you define. Drag to rotate the box.

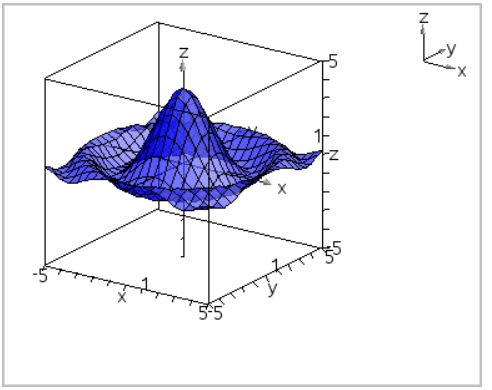
Graphing 3D Functions

1. In the 3D Graphing view, select **3D Graph Entry/Edit > Function**.

   The entry line appears.

2. Enter the expression that defines the graph. You can type the expression or build it using expression templates.

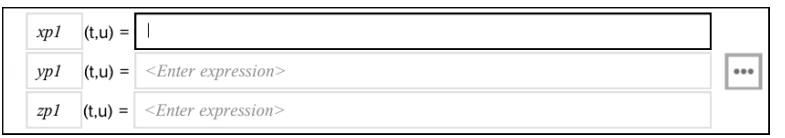
3. Press **Enter** to create the graph and hide the entry line. You can show or hide the entry line anytime by pressing **Ctrl+G**.



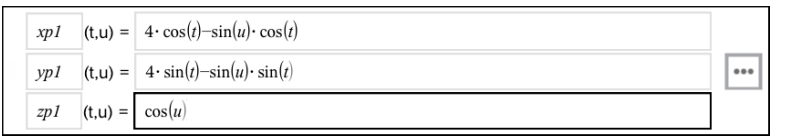
Graphing 3D Parametric Equations

1. In the 3D Graphing view, select **3D Graph Entry/Edit > Parametric**.

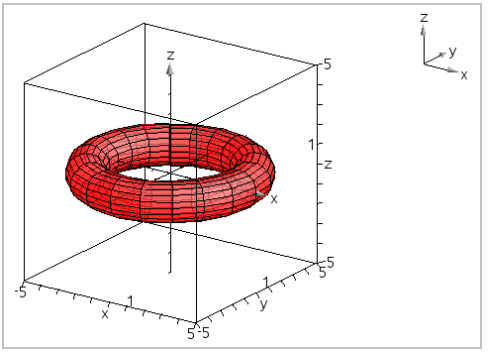
   The entry line appears.



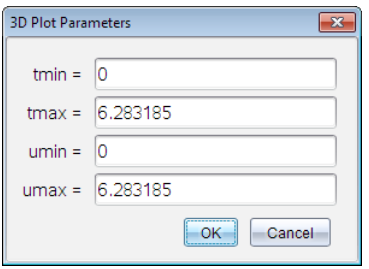
2. Type the equations that define the graph.



3. Press **Enter** to draw the graph and hide the entry line and keyboard. You can show or hide the entry line anytime by pressing **Ctrl+G**.



4. To set the graphing parameters *tmin*, *tmax*, *umin*, and *umax*, display the graph's context menu, and select **Edit Parameters**.



Rotating the 3D View

Rotating Manually

1. Press **R** to activate the Rotation tool.
2. Press any of the four arrow keys to rotate the graph.

Rotating Automatically

Auto rotation is equivalent to holding down the right arrow key.

1. Press **A**.

   The Auto Rotation icon appears, and the graph rotates.

2. (Optional) Use the up and down arrow keys to explore the rotating graph.
3. To stop the rotation and return to the Pointer tool, press **Esc**.

Viewing from Specific Orientations

1. If necessary, press **Esc** to return to the Pointer tool.
2. Use letter keys to select the orientation:
   - Press **Z**, **Y**, or **X** to view along the z, y, or x axis.
   - Press letter **O** to view from the default orientation.

Editing a 3D Graph

1. Double-click the graph to show its expression in the entry line.
   —or—
   Display the graph's context menu, and then click **Edit Relation**.

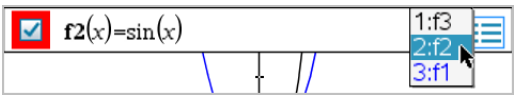
2. Modify the existing expression, or type a new expression in the entry line.
3. Press **Enter**.

For each problem, the software stores a history of relations defined in the Graphs application and 3D Graphing view, such as function graphs **f1** through **f99** and 3D function graphs **z1** through **z99**. You can view and edit these items using a button on the entry line.

Viewing the History

1. Press **Ctrl+G** to show the entry line.
2. Click the **History Menu** button on the entry line.

   The menu is displayed. As you point to the name of each item, its expression appears in the entry line.



3. Select the name of the relation you want to view or edit.
4. (Optional) From the entry line, use the up and down arrow keys to scroll through the defined relations of the same type.

Viewing the History of Specific Relation Types

Use this method if you want to view or edit a defined relation that does not appear in the History menu.

1. On the **Graph Entry/Edit** menu, click the relation type. For example, click **Polar** to show the entry line for the next available Polar relation.
2. Click the **History Menu** button, or use the up and down arrow keys to scroll through the defined relations of the same type.

Changing the Appearance of a 3D Graph

Setting Wire and Surface Color:

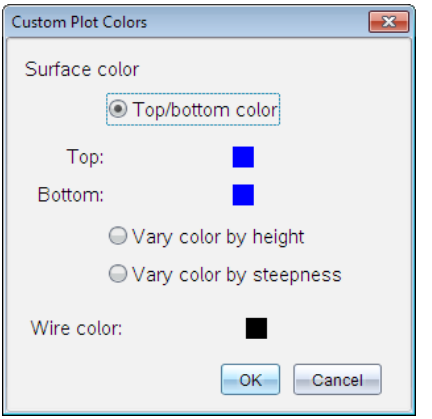
1. Display the graph's context menu, click **Color**, and then click **Line Color** or **Fill Color**.

2. Click a color swatch to apply it.

Setting Custom Plot Colors:

You can assign different colors to a graph's top and bottom surfaces or choose to have the graph colored automatically, based on height or steepness. You can also set the wire color.

1. Display the graph's context menu, and then click **Color > Custom Plot Color**.



2. Select one of the three Surface color options: **Top/bottom color**, **Vary color by height**, or **Vary color by steepness**.
   - If you choose Top/bottom color, click the color swatches to select colors for the top and bottom surfaces.
   - If you choose to vary color by height or steepness, colors are determined automatically.
3. To set the Wire color, click the color swatch and select a color.

Setting Other Attributes of a Graph:

1. Display the graph's context menu, and then click **Attributes**. You can set the following attributes for the selected graph.
   - format: surface+wire, surface only, or wire only
   - x resolution (enter a value in range 2-200*, default=**21**)
   - y resolution (enter a value in range 2-200*, default=**21**)
   - transparency (enter a value in range 0-100, default=**30**)

* Handhelds are limited to a maximum display resolution of 21, regardless of the value entered.

2. Set the attributes as you like, and then press **Enter** to accept the changes.

Showing or Hiding a Graph's Label

▶ Display the graph's context menu, and then click **Hide Label** or **Show Label**.

Showing and Hiding 3D Graphs

1. In the 3D Graphing view, select **Actions > Hide/Show**.

   The Hide/Show tool appears, and all hidden items are displayed in gray.

2. Tap a graph to change its hide/show state.
3. To apply the changes and dismiss the tool, press **Esc**.

Note: If you want to show or hide only the graph's label, see Showing or Hiding a Graph's Label.

Customizing the 3D Viewing Environment

Setting the Background Color

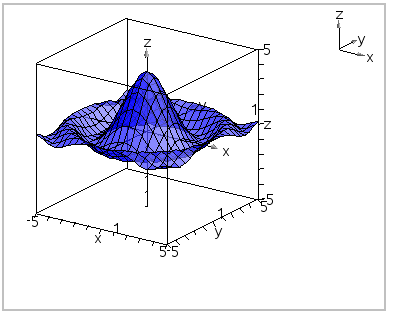
▶ Display the context menu for the work area, and then click **Background Color**.

Showing or Hiding Specific View Elements

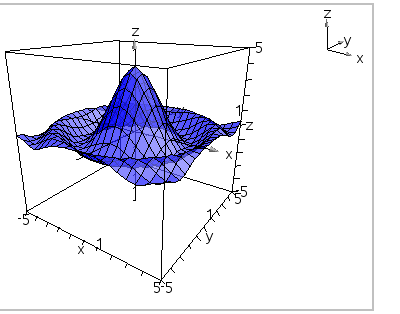
▶ From the **View** menu, click the item to show or hide. You can choose items such as the 3D box, axes, box end values, and legend.

Changing the 3D Projection

▶ From the **View** menu, click **Orthographic Projection** or **Perspective View**.



Orthographic Projection



Perspective View

(default)

Setting the Visual Attributes of the Box and Axes

1. Display the context menu for the box, and then click **Attributes**. You can set the following attributes.
   - Show or hide tic labels
   - Show or hide end values
   - Show or hide arrows on axes
   - Show 3D or 2D arrow heads
2. Set the attributes as you like, and then press **Enter** to accept the changes.

Shrinking or Magnifying the 3D View

▶ From the **Range/Zoom** menu, click **Shrink Box** or **Magnify Box**.

Changing the 3D Aspect Ratio

1. From the **Range/Zoom** menu, click **Aspect Ratio**.
2. Enter values for the x, y, and z axes. The default value for each axis is **1**.

Changing the Range Settings

▶ On the **Range/Zoom** menu, click **Range Settings**. You can set the following parameters.

- XMin (default=**-5**)
  XMax (default=**5**)
  XScale (default=**Auto**) You can enter a numeric value.
- YMin (default=**-5**)
  YMax (default=**5**)
  YScale (default=**Auto**) You can enter a numeric value.
- ZMin (default=**-5**)
  ZMax (default=**5**)
  ZScale (default=**Auto**) You can enter a numeric value.
- eye θ° (default=**35**)
  eye ϕ° (default=**160**)
  eye distance (default=**11**)

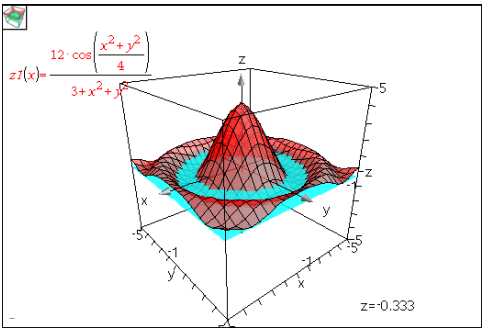
Tracing in the 3D View

1. From the **Trace** menu, select **z Trace**.

The z Trace icon and the trace plane appear, along with a text line showing the current "z=" trace value.

2. To move the trace, hold down **Shift** and press the up or down arrow key.

   The "z=" text is updated as you move.

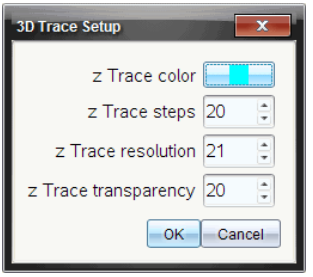


3. (Optional) Use the four arrow keys to rotate the view and see how the trace plane and the graph intersect.
4. To stop tracing and return to the Pointer tool, press **Esc**.

Changing the Trace Settings

1. From the **Trace** menu, select **Trace Setup**.

   The 3D Trace Setup dialog box opens.



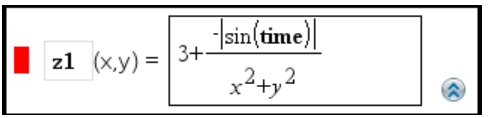
2. Enter or select the settings, and click **OK** to apply them.
3. If you are not already tracing, your new settings take effect the next time you trace.

Example: Creating an Animated 3D Graph

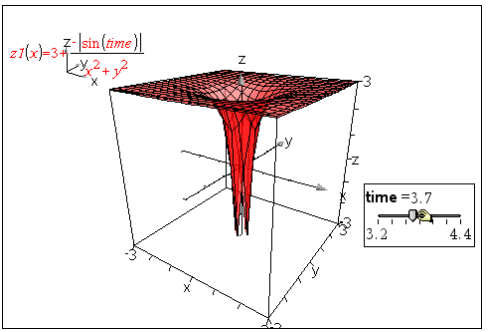
1. Insert a new problem and select the 3D Graphing view.
2. From the **Actions** menu, select **Insert Slider**, click to position it, and type **`time`** as the variable name.
3. Display the slider's context menu, click **Settings**, and enter the following values.

Value: **3.8**
Minimum: **3.2**
Maximum: **4.4**
Step Size: **0.1**

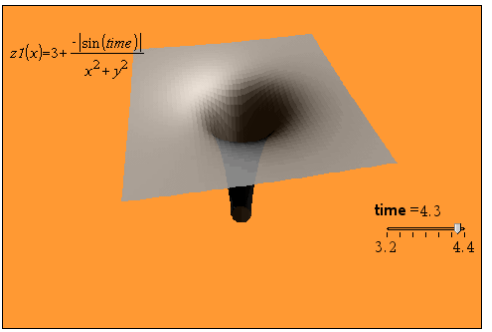
4. In the entry line, define the function shown here:



5. Drag the slider thumb to see the effect of varying *time*.



6. Add visual interest. For example:
   - Change the background color of the work area.
   - Hide the box, axes, or legend.
   - Automatically rotate the graph.
   - Change the graph's fill color and hide its lines.
   - Change the graph's transparency and shading.



7. To animate the graph, display the slider's context menu, and click **Animate**. (To stop, click **Stop Animate** from the context menu.)

You can combine manual or auto rotation with the slider animation. Experiment with the x and y resolution to balance curve definition against animation smoothness.

Lists & Spreadsheet Application

The Lists & Spreadsheet application gives you a place to work with tabular data. It lets you:

- Store numeric data, text, or math expressions.
- Define a table cell in terms of the contents of other cells.
- Define an entire column based on the contents of another column.
- Share columns of data as list variables with other TI-Nspire™ applications. Also share individual cells as variables.
- Work with variables created in the Graphs & Geometry and Calculator applications.
- Collect tables of real-world data from sensors.
- Generate columns of data-based sequences that you define.
- Plot table data using the Data & Statistics application.
- Generate a table of values for a function.
- Copy and paste table data from the Lists & Spreadsheet application to other computer applications, such as TI Connect™ software and Excel® spreadsheet software.
- Perform statistical analysis on lists of data.

Adding a Lists & Spreadsheet Page

▶ To start a new document with a blank Lists & Spreadsheet page:

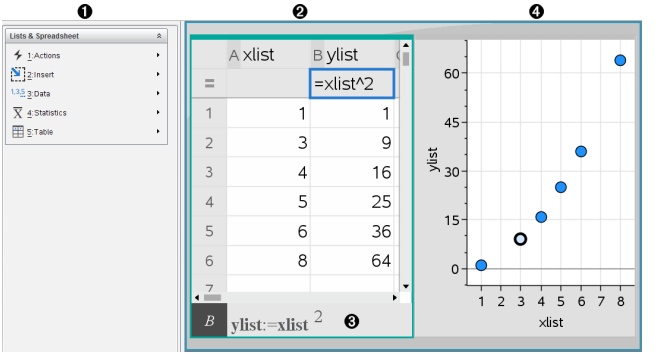
From the main **File** menu, click **New Document**, and then click **Lists & Spreadsheet**.

Handheld: Press [on], and select **Lists & Spreadsheet**.

▶ To add a Lists & Spreadsheet page in the current problem of an existing document:

From the toolbar, click **Insert > Lists & Spreadsheet**.

Handheld: Press [doc] and select **Insert >Lists & Spreadsheet**.



❶ Lists & Spreadsheet tools (available when a Lists & Spreadsheet work area is active)

❷ Sample Lists & Spreadsheet work area

❸ Lists & Spreadsheet entry line

❹ Lists & Spreadsheet data plotted in the Data & Statistics application

Creating and Sharing Spreadsheet Data as Lists

You can define a column as a named list of elements of the same type of data. After defining a list, you can link to it from the Graphs & Geometry, Calculator, or Data & Statistics applications, and from other instances of the Lists & Spreadsheet application within the current problem.

Note: Lists & Spreadsheet can display a maximum of 2500 elements in a list.

Sharing a Spreadsheet Column as a List Variable

You share a column of data by naming it as a list variable.

Note: Avoid defining variables that use the same names as those used for statistical analysis. In some cases, an error condition could occur.

Variable names used for statistical analysis are listed in the *TI-Nspire™ Reference Guide*, under the **stat.results** entry.

1. Click the cell to move to the column's name cell (the top cell of the column).

   —or—

   Press ▲ as necessary.

2. Type a name for the list variable, and press **Enter**.

   The column is now available as a list variable to other TI-Nspire™ applications.

3. Create elements in the list the same as you would create data in spreadsheet cells. For example, you can type the data into each cell or use a formula to generate a column of data.

Notes:

- If a variable with the name you specified already exists in the current problem, Lists & Spreadsheet displays an error message.
- When you select the column formula cell of a list, it displays the list name in an expression similar to **`width:=`**.

- Lists can contain empty elements (denoted by "_") .
- You can refer to a specific element in a named list from the Calculator application. Use the list name and the element's position within the list. In a list named Heights, for example, refer to the first element as Heights[1]. The expression Heights[2] refers to the second element, and so on.

Linking to an Existing List Variable

Linking a column to an existing list variable lets you easily view and edit the values in the list. The list can be any shared list in the current problem and can be defined in Graphs & Geometry, Calculator, or any instance of Lists & Spreadsheet.

After you link a column to a list, Lists & Spreadsheet automatically shows any changes that you make to the list with other TI-Nspire™ applications.

1. Click the column formula cell (the second cell from the top) of the column that you want to link to the variable.
2. Type the name of the list variable you want to link to.

   —or—

   Click var on the toolbar (press var on the handheld), click **Link To**, and click the variable you want to link to.
3. Press **Enter**.

   The column shows the list elements.

Notes:

- You cannot link to the same variable multiple times on the same page.
- Use caution if you link to a system variable. Doing so could prevent the variable from being updated by the system. System variables include *ans* and statistics results (such as *stat.results*, *stat.RegEqn*, and *stat.Resid*).

Inserting an Element in a List

When you insert an element in a list, the remaining elements shift downward to create space. No other columns are affected.

▶ Click **Insert > Insert Cell**.

Deleting an Element from a List

When you delete an element, the remaining list elements shift upward to close the gap. The upward shift affects only the selected column.

1. Click the cell of the element to delete.
2. Open the context menu for the cell, and click **Delete Cell**.

   Note: If you press **Del** or **Backspace** to clear the contents of the cell instead of deleting the list element, the element is assigned a value of 0 (zero). The remaining list elements do not shift.

Creating Spreadsheet Data

You can type numeric values, text, or formulas into body cells. Column formula cells can contain formulas only. (For more information, see *Generating Columns of Data*.)

Data Examples

Entry	Remarks
1.234	Simple numeric entry
“Green”	Text - Enclose categorical data (such as the names of colors used in a study) within quotes to distinguish them from variable names. Handheld: Press ctrl × to enter quoted data.
=a3*length	Formula - Consists of an “=” symbol followed by an expression. You can type the expression or use the Catalog and expression templates to build it. For more information, see the *Calculator* section. To ensure a decimal result instead of a fraction, type one of the integers in the expression as a decimal. For example, type **1.0** instead of **1**.

Typing a Math Expression, Text, or Spreadsheet Formula

1. Double-click the cell to select it and put it in edit mode.

   Note: If the cell is already selected, you can press **Enter** or click the entry line.

2. Type the expression, text, or formula. Be sure to enclose text entries in quotes and start formula entries with an “=” symbol.

   As you type the data, it appears in the cell and on the entry line simultaneously.

3. Press **Enter** to complete the entry and move down to the next cell.

—or—

Press **Tab** to complete the entry and move right to the next cell.

The Lists & Spreadsheet application automatically recalculates any cells that are dependent on the cell you entered. If you have shared the cell, and other TI-Nspire™ applications are linked to the cell, the other applications are also updated.

Note: Empty cells in a spreadsheet display as a void represented by an underscore (_). The underscore is automatically added to empty cells when a list is named or when an empty cell is referenced in a formula. When you plan to perform calculations on a range of cells, be sure to notice the location of void cells. Cells without a value can affect calculations. For example, if you include a void cell in the range for a sum such as "=b2+c2," the result of the calculation is void (_).

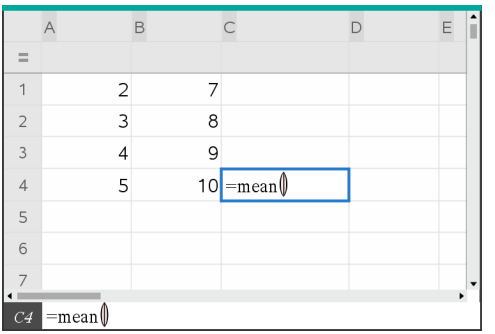
Inserting a Cell Range into a Formula

The Select Range feature lets you insert a cell range (such as a1:b3) into a formula by selecting the range instead of typing cell addresses into an argument.

Suppose you want to calculate the mean of a range of cells.

1. Select the cell that will contain the result.
2. From the **Data** menu, click **List Math > Mean**.

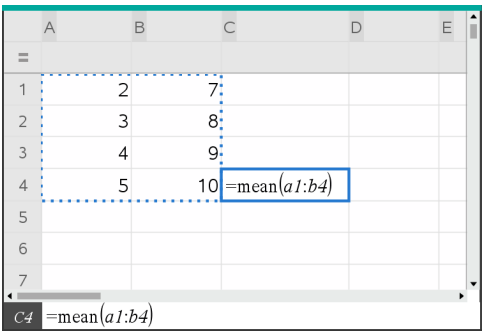
   An editable formula appears in the cell.



3. Click **Actions > Select > Select Formula Range**.
4. Drag a selection rectangle around the range of values for which you want to calculate the mean.

   Handheld: Move to the first cell in the range, hold shift, and press the arrow keys.

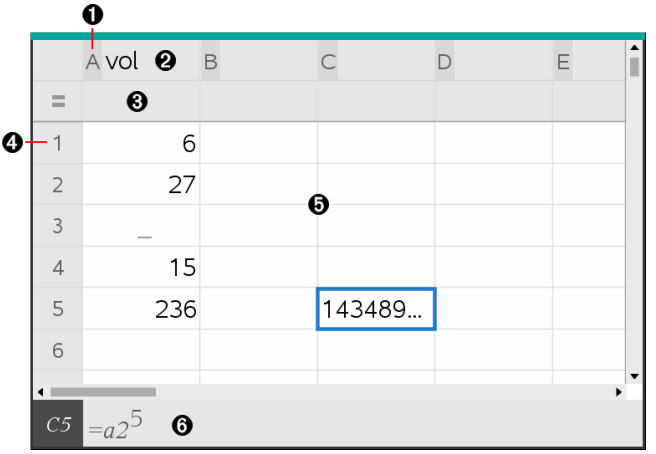
The formula is updated as you select the cells.



5. Press **Enter** to complete the formula and display the result.

Navigating in a Spreadsheet

A spreadsheet includes a column letter at the top of each column and a row number on the left of each row. The top two rows and the row numbers remain in place as you scroll. You can name a column of data to make it available as a list variable in TI-Nspire™ applications.



❶ Column reference letter

❷ Column name cell for defining a column as a list variable

❸ Column formula cell for generating a column of data

❹ Row reference number

❺ Body Cells - Any empty (void) element in a list is displayed as an underscore ("_"). Any value that cannot fit in a cell's width is truncated **(143489...)**. Hover over the cell to display the complete value.

❻ Entry line (includes cell reference for current cell)

You can select any cell to view or edit its contents. When a spreadsheet is larger than the Lists & Spreadsheet work area, you can move to different parts of the spreadsheet by using the **Tab** key and by pressing shortcut keys.

- Press **Tab** to move between the body of the spreadsheet (data zone) and the column names and formulas (naming zone).
- Press ◄, ►, ▲, and ▼ to move through the spreadsheet one cell at a time (move between cells within a zone). The arrow keys move the cursor from cell to cell and scroll as necessary to keep the selected cell in view.
- Move across several cells at a time by pressing **Page up**, **Page Dn**, **Home**, and **End**.

  Handheld: Press ctrl 9 **(Page up)**, ctrl 3 (**Page Dn**), ctrl 7 (**Home**), and ctrl 1 (**End**) keys.
- Use the **Go To** command on the **Actions** menu to select a specific cell. Type the cell's column letter and row number (such as **G16**).
- Press **Enter** to put the selected cell in Edit mode.
- Drag the scroll bar to move vertically without changing the cell or block of cells selected.

Working with Cells

Working with Color

The Lists & Spreadsheet application displays black text and cells with a white background by default. You can change the color of cells and text to emphasize or distinguish data. The colors and the order in which color is assigned is based on the TI-Nspire™ color palette.

Changing the Fill Color of Cells

1. Select the cells to fill with color. You can choose one or more cells in any adjacent cells, columns, or rows.
2. Access the context menu and click **Color > Fill Color**.
3. Click the color to apply to the cells.

Note: If you combine color text and color cells, choose colors carefully to ensure visibility as you work with documents in the software and on the handheld.

Changing the Color of Text

1. Select the cells that contain the text to change. You can choose one or more cells in any adjacent cells, columns, or rows.
2. Access the context menu and click **Color > Text Color**.
3. Click the color to apply to the text. Empty cells in the selection area show the color change when text is added.

Understanding Cell References in Formulas

Use a cell reference to use data from a cell or range of cells in a formula. The calculation results update automatically when values in cells change.

Relative references include only the cell's column letter and row number (for example, E7). A relative reference describes where a cell is in relation to other cells of the spreadsheet. The Lists & Spreadsheet application keeps track of relative cell references and adjusts the reference automatically when surrounding cells shift (because of actions you perform, such as column deletions or cell insertions).

Follow these guidelines to specify cell references:

- Include a column letter and row number in a relative reference.
- Include the $ symbol before both the column letter and the row number to specify an absolute reference.
- Include a colon (:) between a two cell reference to specify a range of cells.

Absolute references include the $ symbol before the column letter and before the row number (for example, B16). Absolute references always refer to the cell in a specific position in the spreadsheet. The application does not automatically adjust the cell reference when cell positions change.

Typing a Cell Reference in a Formula

1. Double-click the cell and type the formula. For more information, see the *Calculator* section.
2. Move to the appropriate position in the formula and type the cell reference. Use the format for a relative reference (B3), absolute reference (B2), or range of cells (A1:A4).

Note: You can click **Recalculate** on the **Actions** menu to update all references and formula results in a spreadsheet.

Deleting the Contents of Cells

1. Click a cell to select it.

   —or—

   Use the arrow keys to move to the cell.

   Note: If you are deleting a range of cells, select a cell at one end or corner of the range, and then use **Shift** with the arrow keys to select the remaining cells in the range.

2. Press **Del**.

   Note: Any cell that uses a formula with an absolute reference to deleted data shows an error. A cell that uses a formula with a relative reference to deleted data is updated to use the data currently in the referenced position.

Copying Cells

When you copy cells, any formulas in the original cells are copied to the destination cells.

1. Click the cell to copy.

   —or—

   Use the arrow keys to move to the cell.

   Note: If you are copying a range of cells, select a cell at one end or corner of the range, and then use **Shift** with the arrow keys to select the remaining cells in the range.

2. Use the standard key shortcut for copying a selection.

   Windows®: Press **Ctrl**+**C**.

   Mac®: Press ⌘+**C**.

   Handheld: Press ctrl **C**.

3. Click the cell where you want to duplicate the copied cell. If you are copying a block of data, click the cell that will become the upper left corner of the copied block.
4. Paste the selected cells:

Windows®: Press **Ctrl+V**.

Mac®: Press ⌘+**V**.

Handheld: Press ctrl **V**.

Important: Paste copied data into a cell that is in the same mode as the cell from which the data was originally copied. Otherwise, a formula could paste as a string enclosed in quotes instead of a formula.

Filling Adjacent Cells

You can repeat a cell's formula or value throughout adjacent cells within the row or column. You can also repeat a range of cells horizontally or vertically. If you fill from a range that contains a simple sequence (such as 2, 4, 6), the sequence continues in the filled cells.

1. Click the cell that contains the value or formula to repeat.

   Note: If you are repeating a range of cells, drag to select the range, or select a cell at one end of the range, and then use **Shift** with the arrow keys to select the remaining cells.

2. Click **Data > Fill**.
3. Use the arrow keys, or drag to select the range that will hold the repetitions.
4. Press **Enter**.

   The value, formula, or pattern that you selected for duplication is repeated over the selected range.

Sharing a Cell Value as a Variable

You can share the value of a cell with other TI-Nspire™ applications by storing it as a variable. When you define or refer to a shared cell or variable in Lists & Spreadsheet, the name is preceded with an apostrophe (').

1. Click the cell that you want to share.
2. Click var on the toolbar, and click **Store Var** to store the cell's value.

   Handheld: Press ctrl var or press var and select **Store Var**).

   A formula is inserted into the cell with *var* as a placeholder for a variable name.

3. Type over the letters "*var*" with a name for the variable, and press **Enter**. Use a variable name that does not exist in the current problem.

The value is shown in bold to indicate that it is now available as a variable to other TI-Nspire™ applications.

Linking a Cell to a Variable

When you link a cell to a variable, Lists & Spreadsheet keeps the cell value updated to reflect the current value of the variable. The variable can be any variable in the current problem and can be defined in Graphs & Geometry, Calculator, Data & Statistics, or any instance of Lists & Spreadsheet.

1. Click the cell that you want to link to a variable.
2. Click  on the toolbar, and click **Link to**.

   Handheld: Press ctrl var or press var and select **Link to**.

   The VarLink menu opens.
3. Under **Link To**, press ▲, and ▼ to scroll to the name of the variable.
4. Press **Enter**.

   The cell shows the value of the variable.

Note: Use caution if you link to a system variable. Linking could prevent the variable from being updated by the system. System variables include statistics results (such as *Stat.RegEqn*, *Stat.dfError*, and *Stat.Resid*) and finance-solver variables (such as *tvm.n*, *tvm.pmt*, and *tvm.fv*).

Working with Rows and Columns of Data

Selecting a row or column

- To select a column, move to the top of the column and click the column reference letter. To select a row, move to the leftmost cell of the row and click the row reference number. Press **Esc** to cancel the selection.

  Handheld: Hold down ▲ to move past the top cell, or hold down ◄ to move past the leftmost cell.

- To extend a selection to adjacent rows or columns, hold down **Shift** and press ◄, ►, ▲, or ▼.

Resizing a Row or Column

1. Click the row or column that you want to resize.
2. From the **Actions** menu, select **Resize**, and then select an option.

3. Choose a resizing option for a column or row.
   - For a column, choose **Resize Column Width**, **Maximize Column Width**, or **Minimize Column Width**.
   - For a row, you can choose **Resize Row Height**.

   The tools that minimize and maximize the column width work automatically. You must manually adjust the size to use the **Resize Column Width** and **Resize Row Height** tools.
4. To resize manually, use ◄ and ► to resize the column, or use ▲ and ▼ to resize the row, and then press **Enter**.

Inserting an Empty Row or Column

1. Click a column or row where you want to insert the new data.
2. From the **Insert** menu, select either **Row** or **Column**.
   - If you are inserting a row, the remaining rows shift down to create space for the new row.
   - If you are inserting a column, the remaining columns shift right to create space.

   Note: If other cells contain formulas with relative references to a displaced row or column, those references adjust accordingly.

Deleting Entire Rows or Columns

You can delete a row, column, group of rows, or group of columns. When you delete a row or column, the remaining rows or columns move up or left to fill the gap.

1. Click the column or row that you want to delete.
2. (Optional) To select adjacent rows or columns to delete, hold down **Shift** and press ◄, ►, ▲, or ▼.
3. Display the context menu.
   - Windows®: Right-click the selected row.
   - Mac®: Hold the ⌘ key, and click the selected row.
   - Handheld: Press ctrl menu.
4. On the context menu, select **Delete Row**.

   The selected rows or columns are deleted.

Note: If other cells contain formulas that refer to the deleted row or column, those cells show an error. Relative references to cells whose positions have changed because of a deletion adjust accordingly.

Copying Rows or Columns

1. Click the row number to copy a row, or click the column letter to copy a column.
2. (Optional) To select adjacent rows or columns to copy, hold down **Shift** and press ◄, ►, ▲, or ▼.
3. Copy the row or column:

   Windows®: Press **Ctrl**+**C**.

   Mac®: Press ⌘+**C**.

   Handheld: Press ctrl **C**.
4. Move to any cell in the row or column where you want to place the copied items.
5. Paste the row or column:

   Windows®: Press **Ctrl**+**V**.

   Mac®: Press ⌘+**V**.

   Handheld: Press ctrl **V**.

   The copied row or column is pasted in place, replacing the previous contents.

   Note: If you copy a named column, it is pasted with the name removed to prevent a variable conflict.

Moving a Column

1. Click the column that you want to move.
2. From the **Actions** menu, select **Move Column**.

   An insertion bar appears.
3. Press ◄ and ► to place the insertion bar at the column's new position, and then press **Enter**.

   Note: Relative references to any cell in a position is affected by the move adjust accordingly.

Displaying Results as Exact or Approximate

You can choose to display a column's calculated results in Exact (fraction) or Approximate (decimal) form. This affects only the values calculated from a formula.

1. Select the column by clicking the reference letter at the top of the column.

   Handheld: Hold down ▲ to move past the top cell.

2. Display the context menu for the column.
3. On the context menu, click either **Data > Exact** or **Data > Approximate**.

Note: To restore the column results to the document's default setting, select the column and click **Data > Restore Document Setting**.

Clearing Column Data

The Clear Data command lets you remove the data from selected columns. Clear Data does not delete the column, and it does not clear a column's name or formula.

After clearing the data, Lists & Spreadsheet recalculates column formulas for the selected columns. This makes Clear Data useful for capturing a fresh set of data from another application or selectively generating a fresh column of random numbers.

1. Click the column or columns that you want to clear.
2. From the **Data** menu, select **Clear Data**.

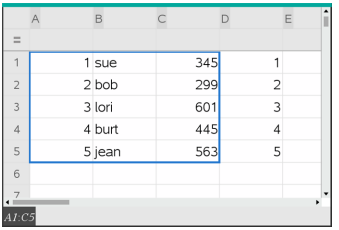
   Note: If a recalculated formula produces the same data as before, it may appear that the Clear Data command has failed.

Sorting Data

You can sort a selected area of the spreadsheet in ascending or descending order. You select which column in the selected area will be used as the key for the sort. When the sort moves data up or down in the key column, the corresponding data in the other selected columns is also moved up or down. This preserves the integrity of each row.

Note: Sorting is based on numeric values. If you select a key column that contains text, you could get unexpected results.

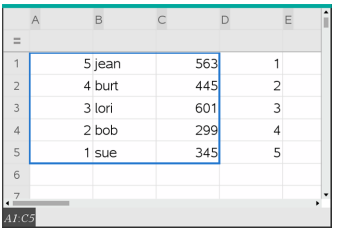
1. Select the range of cells.



2. From the **Actions** menu, select **Sort**.

   The **Sort** dialog box opens.

3. Click the column letter to use for ordering.
4. Click **Descending** or **Ascending** as the sort method, and then click **OK**.

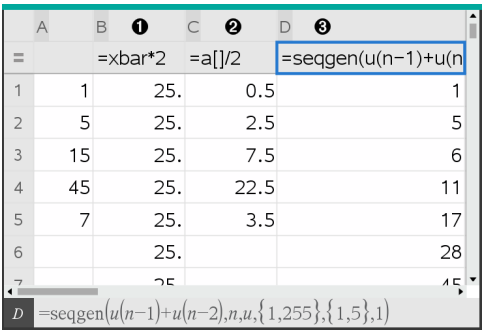


Note: Sorting a column that is defined by a formula will remove the formula, because it may not be valid after the sort.

Generating Columns of Data

You can create a column of values based on the contents of another column. You can also create a column based on any of several types of sequential data.

Entering a formula in a column's formula cell tells the Lists & Spreadsheet application that you want to apply the formula to all cells in the column, not just to a single cell.



❶ Column formula based on a variable

❷ Column formula based on another column (column A)

❸ Column formula that generates a sequence

Notes:

- If you generate data in a column that already contains one or more cell values, Lists & Spreadsheet asks for confirmation before replacing the existing values. Proceeding removes all of the existing values in the column.
- If you edit a cell manually in a column of generated data, Lists & Spreadsheet asks for confirmation before replacing the generated data. Proceeding removes the generated data for the entire column.

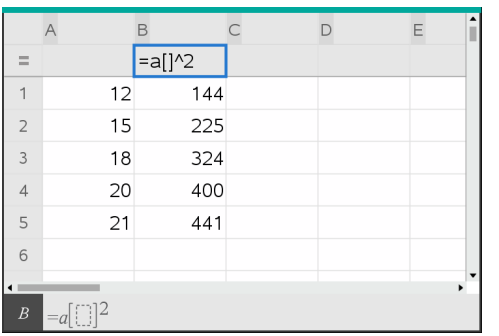
Creating Column Values Based on Another Column

1. Click the column formula cell (the second cell from the top) of the column where you want to use a formula.

   Lists & Spreadsheet inserts the leading equal sign (=) for the formula. If the column is a named list, Lists & Spreadsheet inserts *listname*:= followed by the cursor.

2. Type the expression for the formula after the = and press **Enter** Use brackets (**[]**) after any column letter you include in the formula. For example, type **=a[]^2** to create a column of values in which each cell is the square of the corresponding cell of column A.

   Lists & Spreadsheet shows the formula in the formula cell and fills the column with the results.



Generating a Column of Random Numbers

This example generates a column of 20 random integers in the range 1 through 6.

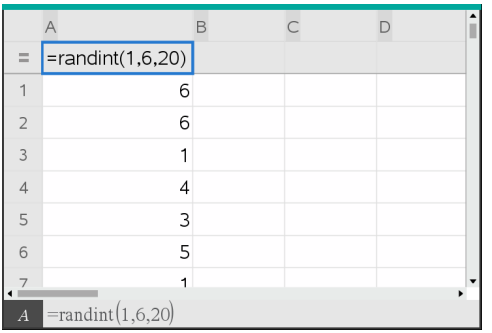
1. Click the column formula cell (the second cell from the top) of the column.

   Lists & Spreadsheet inserts the leading equal sign (=) for the formula. If the column is a named list, Lists & Spreadsheet inserts *listname*:= followed by the cursor.

2. After the equal sign, type **`RandInt(1,6,20)`**.

   Note: You can also use the Catalog or click **Data > Random > Integer** to insert the **RandInt()** function.

3. Press **Enter** to generate the numbers.



4. Generate (Recalculate) a new set of random numbers:

   Windows®: Press **Ctrl+R**.

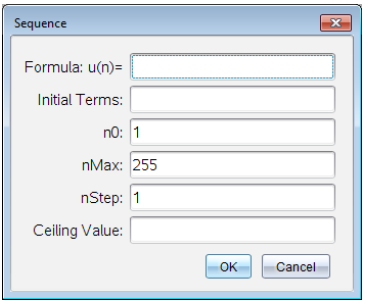
   Mac®: Press **⌘+R**.

   Handheld: Press ctrl **R**.

Generating a Numerical Sequence

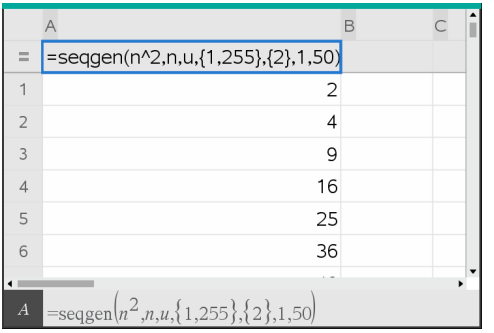
1. Click any cell in the column in which you want to generate the sequence.
2. From the **Data** menu, select **Generate Sequence**.

   The Sequence dialog box opens.



3. Type the **Formula** that will be applied to the column values.
4. Type any **Initial Terms** required by the sequence. Separate them with commas.
5. Type a starting value for the independent variable (**n0**).
6. Type a maximum number of values to be generated (**nMax**).
7. Type the step value (**nStep**).
8. (Optional) Type a maximum value for the sequence in the **Ceiling Value** field.
9. Click **OK**.

   Lists & Spreadsheet shows the formula in the formula cell and fills the column with the results.



Graphing Spreadsheet Data

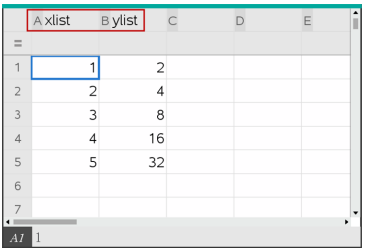
You can graph the data in a spreadsheet using Quick Graph or Summary Plot.
Lists & Spreadsheet cells that contain no data are not represented by data points on graphs.

Using Quick Graph

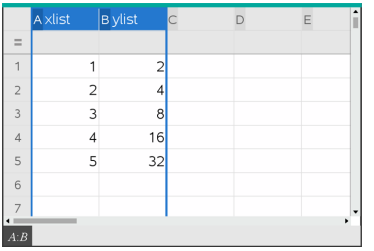
You can easily create a dot plot of the data in one column or a scatter plot of two adjacent columns by using the Quick Graph feature. This feature displays the graphed data using the Data & Statistics application.

To create a scatter plot:

1. Name both of the columns to declare them as lists.

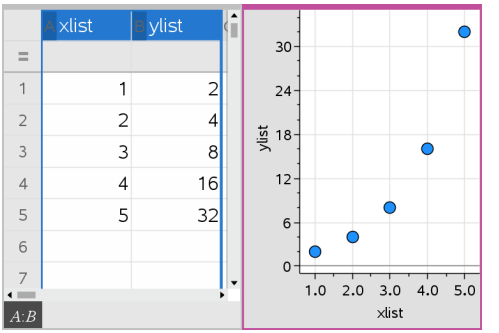


2. Select both columns.



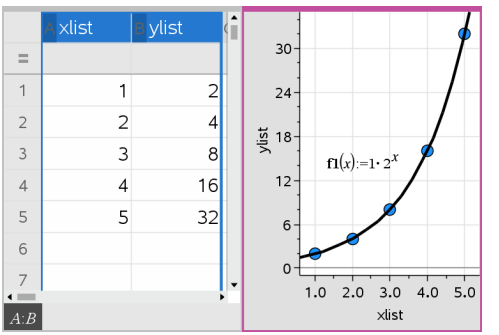
3. From the **Data** menu, select **Quick Graph**.

   A Data & Statistics application is added to the page with the plotted data. The leftmost of the two lists is plotted on the x axis, and the other list is plotted on the y axis.



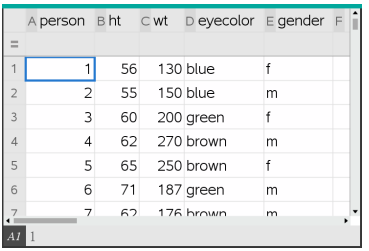
4. (Optional) Use the Data & Statistics features to analyze or visually enhance the graph.

   Note: For more information, see *Using Data and Statistics*.



Creating a Summary Plot from a Summary Table

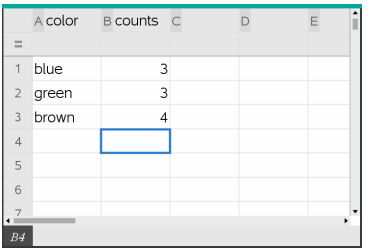
In this example, you create a summary table from raw data, and then use the table to generate a summary plot. For more information, see *Using Data & Statistics*.



	A person	B ht	C wt	D eyecolor	E gender	F
1	1	56	130	blue	f	
2	2	55	150	blue	m	
3	3	60	200	green	f	
4	4	62	270	brown	m	
5	5	65	250	brown	f	
6	6	71	187	green	m	
7	7	62	176	brown	m	

A1 1

Raw data



	A color	B counts	C	D	E
1	blue	3			
2	green	3			
3	brown	4			
4					
5					
6					
7					

B4

Summary table for eye color based on raw data

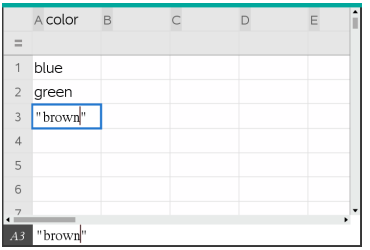
A summary table contains an X (or Y) List and a Summary List.

- The X (or Y) List contains numeric or string values (such as 1999 or “color”). Numeric values result in a histogram. String values identify the categories for a bar chart.
- The Summary List contains numeric values (such as count, frequency, or probability) for each element in the other list.

To Create a Summary Plot:

Note: For situations in which you already have a summary table, you can skip the first two steps.

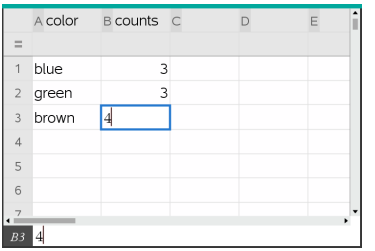
1. Create a list that holds the category identifiers. For this example, name the list “color” and type strings for eye color. Enclose category names in quotes to prevent them from being interpreted as variables.



	A color	B	C	D	E
1	blue				
2	green				
3	"brown"				
4					
5					
6					
7					

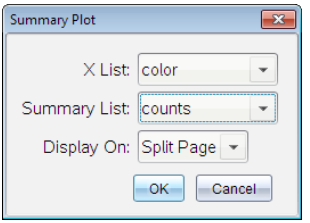
A3 "brown"

2. Create the summary list. For this example, name the list “counts” and type the total count for each of the eye colors.



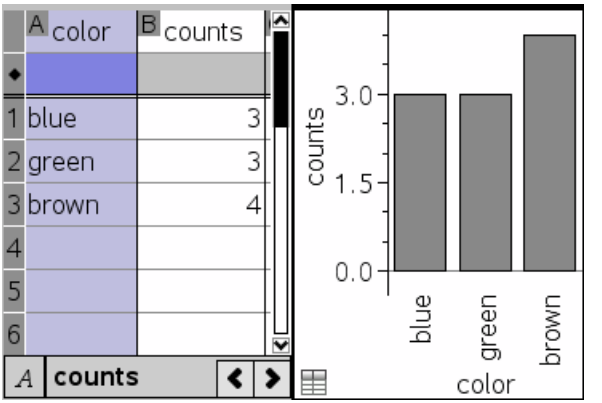
3. Select either list by clicking the top cell of the column and pressing ▲.
4. From the **Data** menu, select **Summary Plot**.

   The Summary Plot dialog box opens.



5. If necessary, use **Tab** and the arrow keys to select the correct lists for **X List** and **Summary List**.
6. In the **Display On** field, select how to display the summary plot in the Data & Statistics application.
   - Select **Split Page** to place the chart on half of the current page.
   - Select **New Page** to add the chart on a new page.

   The summary plot is displayed with the list names along the axes and a summary plot symbol in the lower left corner of the chart window.



Note: In this example, the X List contains string data, so the summary plot displays as a bar chart. The category strings from the list display beneath the bars.

Exchanging Data with Other Computer Software

You can use the TI-Nspire™ desktop software to copy table data to and from software outside the TI-Nspire™ applications, such as TI DataEditor (in the TI Connect™ software) and Excel® spreadsheet software.

For example, you can copy:

- The values of individual cells, a range of cells, or an entire list from TI DataEditor.
- The values (not the underlying formulas) of individual cells, a range of cells, or an entire column from an Excel® spreadsheet.
- A number from TI DataEditor.
- The value of a matrix from TI DataEditor.

Example - Copying Data from TI DataEditor

1. Open the TI Connect™ software.
2. Display the TI DataEditor.
3. If necessary, open the file containing the number, list, or matrix that you want to copy.

	L6
1	1.5567
2	2.2256
3	3.987
4	7.5326
5	13.33
6	

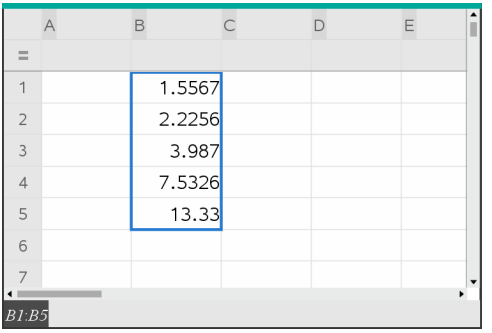
4. Drag to select the values that you want to copy. To copy an entire list, click the top cell in the list.

	L6
1	1.5567
2	2.2256
3	3.987
4	7.5326
5	13.33
6	

5. Click **Edit > Copy**.
6. In Lists & Spreadsheet, click the cell where you want the data to be pasted.

   If you have copied a range of cells, they will be pasted so that the upper-left corner of the range is positioned at the selected cell. Any data in those cells will be overwritten.

7. Click **Edit > Paste**.



Copying Cells from an Excel® Spreadsheet

You can copy up to 26 columns and 2500 rows from an Excel® spreadsheet to a Lists & Spreadsheet application.

1. Drag to select the values that you want to copy from the Excel® spreadsheet. To copy an entire column, click the column identifier at the top of the column.

   Note: If you select non-contiguous columns in the Excel® spreadsheet, they will be pasted as contiguous columns in Lists & Spreadsheet.

2. Use the standard key shortcut for copying a selection.

   Windows®: Press **Ctrl**+**C**.

   Mac®: Press **⌘**+**C**.

3. In Lists & Spreadsheet, click the cells where you want the data to be pasted.

   If you are copying a range of cells, they will be pasted so that the upper-left corner of the range is positioned at the selected cell. Any data in those cells in will be overwritten.

4. Paste the data.

   Windows®: Press **Ctrl**+**V**.

   Mac®: Press **⌘**+**V**.

   Handheld: Press ctrl **V**.

   Note: Categorical data must be enclosed in quotes (“ “) after the data is pasted.

Capturing Data from Graphs & Geometry

You can use Lists & Spreadsheet application to capture information about objects in the Graphs & Geometry application. For example, you could track changes in the area of a triangle as you change the length of a side in the Graphs & Geometry application.

Captured values replace values in the column. If you prefer, you can remove all data from a column before starting a new capture by clicking **Clear Data** on the **Data** menu.

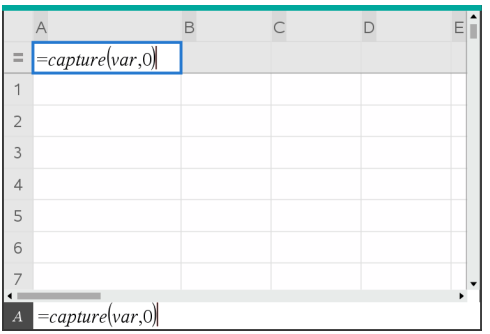
Capturing Data Manually

1. Make sure the data value that you want to capture is linked to a variable name.
2. Click the column formula cell (the second cell from the top) of the column in which you want to capture the values.

   Note: Captured values replace values in the column.

3. Click **Data > Data Capture >Manual**.

   A capture expression is inserted into the column formula cell with *var* as a placeholder for the name of the variable you are capturing.



4. Replace the letters "*var*" with the name of the variable to capture from Graphs & Geometry. For example, type **area**.

   The formula cell now contains an expression similar to **=capture(area,0)**.

   Note: The argument "0" tells Lists & Spreadsheet that you want to trigger each capture manually.

5. Press **Enter**.

6. From the Graphs & Geometry application, change the object with a measured value stored as the variable (area, in this example) referenced in the data capture expression.

7. Each time you are ready to capture the current value of area, press the capture keys.

   Windows®: Press **Ctrl+.** (the period key).

   Mac®: Hold down ⌘ and press **.** (the period key).

   Handheld: Press ctrl .

   The current *area* value is added to the end of the list as a list element.

Capturing Data Automatically

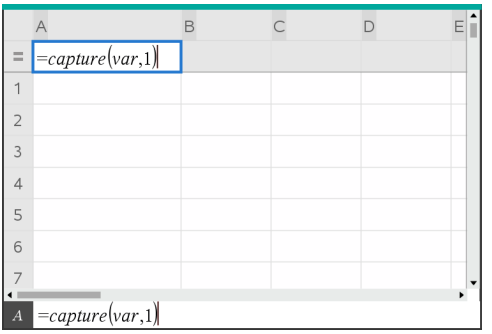
When you capture data automatically, you can specify that you want the captures to be triggered by:

- Changes in the captured variable only.
- Changes in the captured variable or additional variables.

This lets you set up multiple columns of synchronized captures, such as the x and y coordinates of a moving object.

1. Clear all columns that you will be using for the captured data.
2. Make sure any data values that you want to capture are linked to variable names.
3. Click the column formula cell (the second cell from the top) of the column in which you want to capture the values.
4. Click **Data >Data Capture >Automatic**.

   A capture expression is inserted into the column formula cell with *var* as a placeholder for the name of the variable you are capturing.



5. Replace the letters “var” with the name of the variable to capture. For example, type **objpathX**. Alternatively, you can select the variable name from the Variables menu.

   The formula cell now contains an expression similar to **=capture(objpathX,1)**.

   Note: The argument “**1**” tells Lists & Spreadsheet that you want the captures to be triggered by the variable change.

6. If you want the capture to also be triggered by changes in an additional variable or variables, type a comma after the **1**, and then type the variable name or the name of a list that itemizes the variables.

   The formula cell will contain an expression similar to **=capture (objpathX,1,objpathY)**.

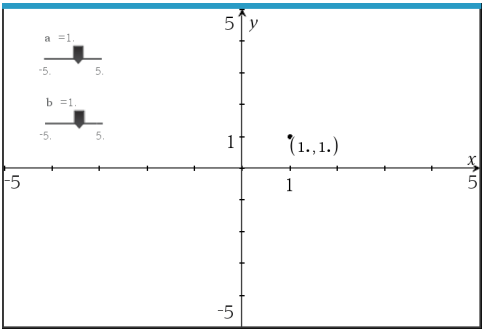
7. Press **Enter** to complete the formula.
8. If you are capturing multiple columns of synchronized data, set up the additional columns. For example, you might set up a second capture variable using **=capture(objpathY,1,objpathX)**.
9. When you are ready to capture the values, begin moving the object or start the animation that affects it in Graphs & Geometry.

   Each captured value is added to the end of the list.

Synchronizing Captured Data for a Point

To ensure that both coordinate values for a point are captured even if only one coordinate changes, you can add **{'a,'b}** in the third argument of the capture expression.

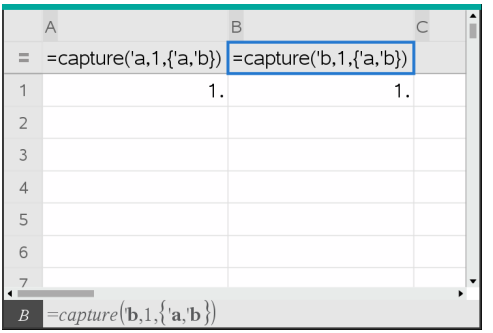
1. In a Graphs & Geometry application, create a point with variables (**a**,**b**).



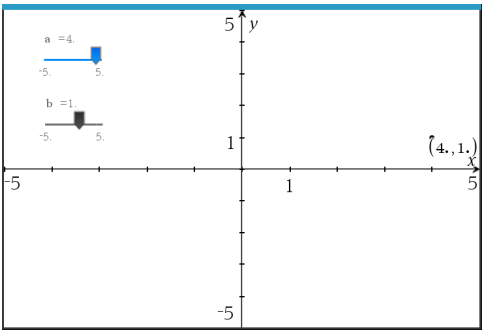
2. Add a Lists & Spreadsheets application to the problem.
3. Enter the capture expressions for both variables.

   Column A: **=capture('a,1,{'a,'b})**

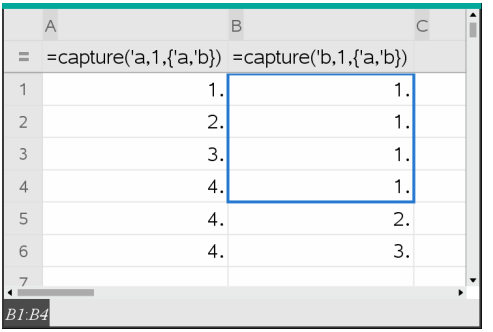
   Column B: **=capture('b,1,{'a,'b})**



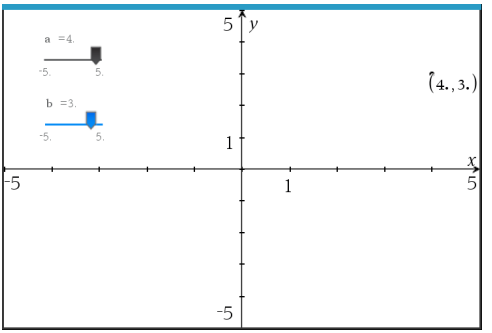
4. Move the slider for variable **a**.



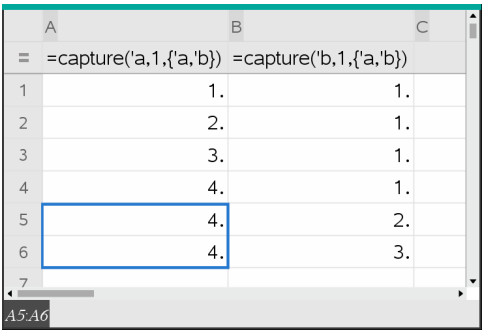
The data captured for **b** synchronizes accordingly.



5. Move the slider for variable **b**.



The data captured for **a** synchronizes accordingly.



	A	B	C
=	=capture('a,1,{'a,'b})	=capture('b,1,{'a,'b})	
1	1.	1.	
2	2.	1.	
3	3.	1.	
4	4.	1.	
5	4.	2.	
6	4.	3.	
7			

A5:A6

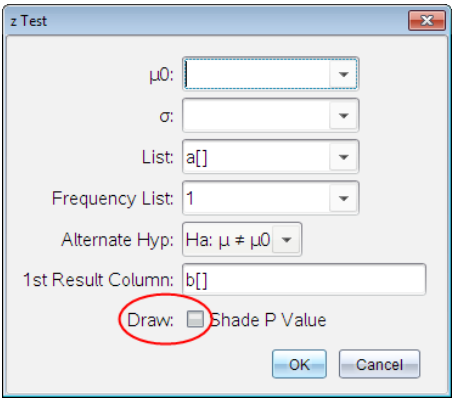
Using Table Data for Statistical Analysis

Tools on the Statistics menu provide access to wizards that help you perform statistical analyses on the data in table columns. You specify the location of the data, and Lists & Spreadsheet stores the results in two columns: one for the result names, and one for the corresponding values.

Plotting Statistical Data

Some statistics wizards include a **Draw** check box. By default, the box is not selected. Selecting this box creates a Data & Statistics work area on the page, displays the calculated results in Lists & Spreadsheet, and draws the results of the statistical analysis in the Data & Statistics work area.

Note: For functions that support the **Draw** option, the option is available only if you type the function in a column formula cell.



***Draw** check box (as shown in the **z Test** wizard).*

Statistics Input Descriptions

The following table describes the different inputs used in Lists & Spreadsheet wizards.

Input	Description
μ_0	Hypothesized value of the population mean that you are testing.
σ	The known population standard deviation; must be a real number > 0.
List	The name of the list containing the data you are testing.
Frequency List	The name of the list containing the frequency values for the data in **List**. Default=1. All elements must be integers ≥ 0. The frequency values can also be typed as a list, in the format {1, 1, 3, 2}.
$\bar{x}$, Sx, n	Summary statistics (mean, standard deviation, and sample size) for the one-sample tests and intervals.
$\sigma 1$	The known population standard deviation from the first population for the two-sample tests and intervals. Must be a real number > 0.
$\sigma 2$	The known population standard deviation from the second population for the two-sample tests and intervals. Must be a real number > 0.
List 1, List 2	The names of the lists containing the data you are testing for the two-sample tests and intervals.

Input	Description
Frequency 1, Frequency 2	The names of the lists containing the frequencies for the data in **List 1** and **List 2** for the two-sample tests and intervals. Defaults=1. All elements must be integers ≥ 0.
$\bar{x}1$, Sx1, $n1$, $\bar{x}2$, Sx2, $n2$	Summary statistics (mean, standard deviation, and sample size) for sample one and sample two in two-sample tests and intervals.
Pooled	Specifies whether variances are to be pooled for **2-Sample t Test** and **2-Sample t Interval**.
p_0	The expected sample proportion for **1-Prop z Test**. Must be a real number, such that $0 < p_0 < 1$.
x	The count of successes in the sample for the **1-Prop z Test** and **1-Prop z Interval.** Must be an integer ≥ 0.
n	The count of observations in the sample for the **1-Prop z Test** and **1-Prop z Interval**. Must be an integer > 0.
x1	The count of successes from sample one for the **2-Prop z Test** and **2-Prop z Interval**. Must be an integer ≥ 0.
x2	The count of successes from sample two for the **2-Prop z Test** and **2-Prop z Interval**. Must be an integer ≥ 0.
n1	The count of observations in sample one for the **2-Prop z Test** and **2-Prop z Interval**. Must be an integer > 0.
n2	The count of observations in sample two for the **2-Prop z Test** and **2-Prop z Interval**. Must be an integer > 0.
C-Level	The confidence level for the interval instructions. Must be ≥ 0 and < 100. If it is ≥ 1, it is assumed to be given as a percent and is divided by 100. Default=0.95.
RegEQ	The prompt for the name of the function where the calculated regression equation is to be stored.

Statistical Calculations

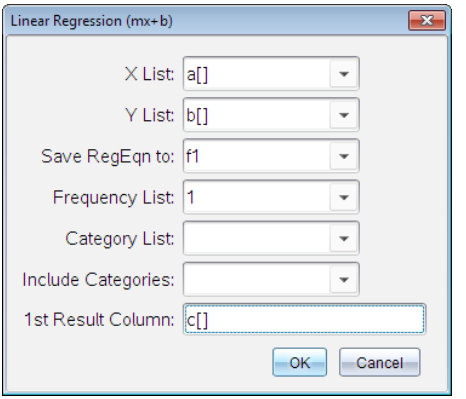
Performing a Statistical Calculation

You can perform statistical calculations to analyze data. The following example fits a y=mx+b linear regression model to the two lists in columns A and B.

1. From the **Statistics** menu, select **Stat Calculation > LinearRegression (mx+b)** to choose the regression model.

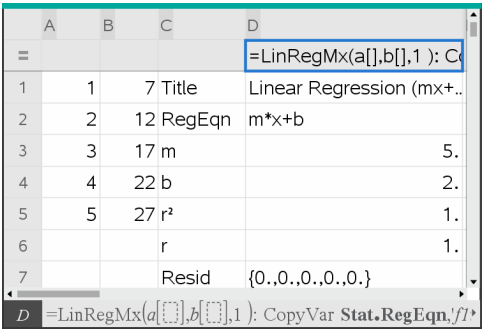
   The Linear Regression (mx+b) dialog box opens.

2. Type **a[]** as the column for the **X List**.
3. Type **b[]** as the column for the **Y List**.
4. To store the regression equation in a specified variable, replace **Save RegEqn To** with the name of the variable.
5. Type **c[]** as the column for the **1st Result**.



6. Click **OK**.

   Lists & Spreadsheet inserts two columns: one containing the names of the results, and one containing the corresponding values.



Note: The results are linked to the source data. For example, if you change a value in column A, the regression equation is updated automatically.

Storing Statistical Results

Lists & Spreadsheet stores statistical results using a variable-group name with the format stat.*nnn*, where *nnn* is the result name (for example, stat.RegEqn and stat.Resid). The use of standard names for variables makes it easier to identify and use the statistical variables later. If you want to use a custom variable group instead of the standard name, you can edit the formula in the column formula cell.

You could use the following formula to store the results in the variable group **MystatsB.**

```
=LinRegMx(a[],b[],1 ): CopyVar Stat., MystatsB.
```

Later, you could view the results by entering the following expression in the Calculator application or in another column of the Lists & Spreadsheet application:

```
MystatsB.results
```

Supported Statistical Calculations

The **Stat Calculations** menu lets you select from the calculations described below. For more information, see the *TI-Nspire™ Reference Guide*.

One-Variable Statistics (OneVar)

Analyzes data with one measured variable. You can specify an optional frequency list. The statistical data returned using this analysis technique are:

- Sample mean, $\bar{x}$
- Sum of the data, Σx
- Sum of the squared data, Σx^2
- Sample standard deviation, sx
- Population standard deviation, σx
- Sample size, n
- X-min
- First quartile, Q_1
- Median
- Third quartile, Q_3
- X-max
- Sum of squared deviations, SSx = $\Sigma(x - \bar{x})^2$

Two-Variable Statistics (TwoVar)

Analyzes paired data. *List 1* is the independent variable. *List 2* is the dependent variable. You can specify an optional frequency list. The statistical data returned using this analysis technique are:

For each list:

- Sample mean, $\overline{x}$ or $\overline{y}$
- Sum of the data, Σx or Σy
- Sum of the squared data, Σx^2 or Σy^2
- Sample standard deviation, sx = $s_{n-1}x$ or sy = $s_{n-1}y$
- Population standard deviation, $\sigma x = \sigma_n x$ or $\sigma y = \sigma_n y$
- X-min or Y-min
- First quartile, Q_1X or Q_1Y
- Median
- Third quartile, Q_3X or Q_3Y
- X-max or Y-max
- Sum of squared deviations, SSx = $\Sigma(x - \overline{x})^2$ or SSy = $\Sigma(y - \overline{y})^2$

Additional data:

- Sample size for each data set, n
- Σxy
- Correlation coefficient, R.

Linear Regression (mx+b) (LinRegMx)

Fits the model equation y=ax+b to the data using a least-squares fit. It displays values for **m** (slope) and **b** (y-intercept).

Linear Regression (a+bx) (LinRegBx)

Fits the model equation y=a+bx to the data using a least-squares fit. It displays values for **a** (y-intercept), **b** (slope), $\mathbf{r}^2$, and **r**.

Median-Median Line (MedMed)

Fits the model equation y=mx+b to the data using the median-median line (resistant line) technique, calculating the summary points x1, y1, x2, y2, x3, and y3. **Median-Median Line** displays values for **m** (slope) and **b** (y-intercept).

Quadratic Regression (QuadReg)

Fits the second-degree polynomial $y=ax^2+bx+c$ to the data. It displays values for **a**, **b**, **c**, and $\mathbf{R}^2$. For three data points, the equation is a polynomial fit; for four or more, it is a polynomial regression. At least three data points are required.

Cubic Regression (CubicReg)

Fits the third-degree polynomial $y=ax^3+bx^2+cx+d$ to the data. It displays values for **a**, **b**, **c**, **d**, and $\mathbf{R}^2$. For four points, the equation is a polynomial fit; for five or more, it is a polynomial regression. At least four points are required.

Quartic Regression (QuartReg)

Fits the fourth-degree polynomial $y=ax^4+bx^3+cx^2+dx+e$ to the data. It displays values for **a**, **b**, **c**, **d**, **e**, and $\mathbf{R}^2$. For five points, the equation is a polynomial fit; for six or more, it is a polynomial regression. At least five points are required.

Power Regression (PowerReg)

Fits the model equation y=axb to the data using a least-squares fit on transformed values ln(x) and ln(y). It displays values for **a**, **b**, $\mathbf{r}^2$, and **r**.

Exponential Regression (ExpReg)

Fits the model equation $y=ab^x$ to the data using a least-squares fit on transformed values x and ln(y). It displays values for **a**, **b**, $\mathbf{r}^2$, and **r**.

Logarithmic Regression (LogReg)

Fits the model equation y=a+b ln(x) to the data using a least-squares fit on transformed values ln(x) and y. It displays values for **a**, **b**, $\mathbf{r}^2$, and **r**.

Sinusoidal Regression (SinReg)

Fits the model equation y=a sin(bx+c)+d to the data using an iterative least-squares fit. It displays values for **a**, **b**, **c**, and **d**. At least four data points are required. At least two data points per cycle are required to avoid aliased frequency estimates.

Note: The output of **SinReg** is always in radians, regardless of the Radian/Degree mode setting.

Logistic Regression (d=0) (Logistic)

Fits the model equation y=c/(1+a*e-bx) to the data using an iterative least-squares fit. It displays values for **a**, **b**, and **c**.

Logistic Regression (d≠0) (LogisticD)

Fits the model equation $y=c(1+a*e^{(-bx)})+d$ to the data using an iterative least-squares fit. It displays values for **a**, **b**, **c** and **d**.

Multiple Linear Regression (MultReg)

Calculates multiple linear regression of list Y on lists X1, X2, …, X10.

Distributions

Calculating a Distribution

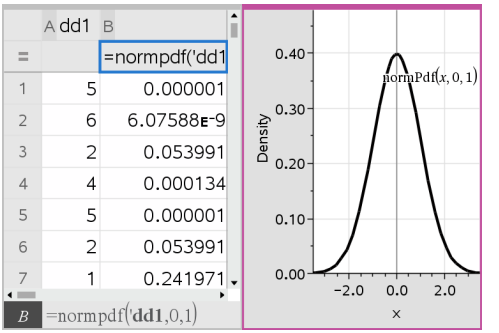
Example: Calculate a distribution to fit the Normal Pdf distribution model.

1. Click the column formula cell (second cell from the top) in column A.
2. Click **Statistics > Distributions > Normal Pdf** to choose the Distribution model.

   The Normal Pdf dialog box opens and displays fields for typing or selecting the arguments for the calculation.
3. Press **Tab** as necessary to move from field to field and provide each argument. You can type values, or select them from the drop down list:
   - **X Value:** Click the drop-down arrow to choose any list in the problem to provide the x values for the calculation.
   - **Mean:** Type a value for the mean or click the drop-down arrow to choose a variable that contains the mean.
   - **Standard Deviation:** Type a value for the standard deviation or choose a variable that contains the standard deviation.
4. Click the **Draw** check box to see the distribution plotted in Data & Statistics.

   Note: The Draw option is not available for all distributions.
5. Click **OK**.

   Lists & Spreadsheet inserts two columns: one containing the names of the results, and one containing the corresponding values. The results are plotted in Data & Statistics.



Note: The results are linked to the source data. For example, you can change a value in Column A, and the equation updates automatically.

Supported Distribution Functions

The following distributions are available from the Lists & Spreadsheet application. For more information regarding these functions, see the *TI-Nspire™ Reference Guide*.

- To return a single distribution result based on a single value, type the function in a single cell.
- To return a list of distribution results based on a list of values, type the function in a column formula cell. In this case, you specify a list (column) that contains the values. For each value in the list, the distribution returns a corresponding result.

  Note: For distribution functions that support the draw option (**normPDF**, **t PDF**, χ^2 **Pdf**, and F **Pdf**), the option is available only if you type the distribution function in a formula cell.

Normal Pdf (normPdf)

Computes the probability density function (**pdf**) for the normal distribution at a specified x value. The defaults are mean μ=0 and standard deviation σ=1. The probability density function (pdf) is:

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \sigma > 0$$

This distribution is used to determine the probability of the occurrence of a certain value in a normal distribution. The draw option is available when Normal PDF is invoked from a formula cell.

When you access distributions from the formula cell, you must select a valid list from the drop-down list to avoid unexpected results. If accessed from a cell, you must specify a number for the x-value. The distribution returns the probability that the value you specify will occur.

Normal Cdf (normCdf)

Computes the normal distribution probability between *Lower Bound* and *Upper Bound* for the specified mean, μ (default=0) and the standard deviation, σ (default=1). You can click the **Draw (Shade area)** check box to shade the area between the lower and upper bounds. Changes to the initial *Lower Bound* and *Upper Bound* automatically update the distribution.

This distribution is useful in determining the probability of an occurrence of any value between the lower and upper bounds in the normal distribution. It is equivalent to finding the area under the specified normal curve between the bounds.

Inverse Normal (invNorm)

Computes the inverse cumulative normal distribution function for a given *area* under the normal distribution curve specified by mean, μ, and standard deviation, σ.

This distribution is useful in determining the x-value of data in the area from 0 to x<1 when the percentile is known.

t Pdf (tPdf)

Computes the probability density function (**pdf**) for the t-distribution at a specified x value. df (degrees of freedom) must be > 0. The probability density function (**pdf**) is:

$$f(x) = \frac{\Gamma[(df+1)/2]}{\Gamma(df/2)} \quad \frac{(1+x^2/df)^{-(df+1)/2}}{\sqrt{\pi df}}$$

This distribution is useful in determining the probability of the occurrence of a value when the population standard deviation is not known and the sample size is small. The draw option is available when **t Pdf** is invoked from a formula cell.

t Cdf (tCdf)

Computes the Student-t distribution probability between *Lower Bound* and *Upper Bound* for the specified df (degrees of freedom). You can click the **Draw (Shade area)** check box to shade the area between the bounds. Changes to the initial *Lower Bound* and *Upper Bound* automatically update the distribution.

This distribution is useful in determining the probability of the occurrence of a value within an interval defined by the lower and upper bound for a normally distributed population when the population standard deviation is not known.

Inverse t (invt)

Computes the inverse cumulative t-distribution probability function specified by Degrees of Freedom, df, for a given area under the curve.

This distribution is useful in determining the probability of an occurrence of data in the area from 0 to x<1. This function is used when the population mean and/or population standard deviation is not known.

χ^2 *Pdf* (χ^2 *Pdf()*)

Computes the probability density function (**pdf**) for the χ^2 (chi-square) distribution at a specified x value. df (degrees of freedom) must be an integer > 0. The probability density function (**pdf**) is:

$$f(x) = \frac{1}{\Gamma(df/2)}(1/2)^{df/2}x^{df/2-1}e^{-x/2}, x \geq 0$$

This distribution is useful in determining the probability of the occurrence of a given value from a population with a χ^2 distribution. The draw option is available when χ^2 **Pdf** is invoked from a formula cell.

χ^2 *Cdf* (χ^2 *Cdf()*)

Computes the χ^2 (chi-square) distribution probability between *lowBound* and *upBound* for the specified df (degrees of freedom). You can click the **Draw Shade area** check box to shade the area between the lower and upper bounds. Changes to the initial *lowBound* and *upBound* automatically update the distribution.

This distribution is useful in determining the probability of the occurrence of value within given boundaries of a population with a χ^2 distribution.

F *Pdf* (F *Pdf()*)

Computes the probability density function (**pdf**) for the F distribution at a specified x value. *numerator df* (degrees of freedom) and *denominator df* must be integers > 0. The probability density function (**pdf**) is:

$$f(x) = \frac{\Gamma[(n+d)/2]}{\Gamma(n/2)\Gamma(d/2)}\left(\frac{n}{d}\right)^{n/2}x^{n/2-1}(1+nx/d)^{-(n+d)/2}, x \geq 0$$

where n = numerator degrees of freedom
d = denominator degrees of freedom

This distribution is useful in determining the probability that two samples have the same variance. The draw option is available when F Pdf is invoked from a formula cell.

F Cdf (F Cdf())

Computes the F distribution probability between *lowBound* and *upBound* for the specified *dfnumer* (degrees of freedom) and *dfDenom*. You can click the **Draw (Shade area)** check box to shade the area between the lower and upper bounds. Changes to the initial *lowBound* and *upBound* automatically update the distribution.

This distribution is useful in determining the probability that a single observation falls within the range between the lower bound and upper bound.

Binomial Pdf (binomPdf())

Computes a probability at x for the discrete binomial distribution with the specified *numtrials* and probability of success (*p*) on each trial. The x parameter can be an integer or a list of integers. $0 \le p \le 1$ must be true. *numtrials* must be an integer > 0. If you do not specify x, a list of probabilities from 0 to *numtrials* is returned. The probability density function (**pdf**) is:

$$f(x) = \binom{n}{x} p^x (1-p)^{n-x}, x = 0,1,\ldots,n$$

where $n = numtrials$

This distribution is useful in determining the probability of success in a success/failure trial, at trial *n*. For example, you could use this distribution to predict the probability of getting heads in a coin toss on the fifth toss.

Binomial Cdf (binomCdf())

Computes a cumulative probability for the discrete binomial distribution with n number of trials and probability p of success on each trial.

This distribution is useful in determining the probability of a success on one trial before all trials are completed. For example, if heads is a successful coin toss and you plan to toss the coin 10 times, this distribution would predict the chance of obtaining heads at least once in the 10 tosses.

Inverse Binomial (invBinom())

Given the number of trials ($NumTrials$) and the probability of success of each trial ($Prob$), this function returns the minimum number of successes, k, such that the cumulative probability of k successes is greater than or equal to the given cumulative probability ($CumulativeProb$).

Inverse Binomial with respect to N (invBinomN())

Given the probability of success of each trial (*Prob*), and the number of successes (NumSuccess), this function returns the minimum number of trials, N, such that the cumulative probability of x successes is less than or equal to the given cumulative probability (*CumulativeProb*).

Poisson Pdf (poissPdf())

Computes a probability at x for the discrete Poisson distribution with the specified mean, μ, which must be a real number > 0. x can be an integer or a list of integers. The probability density function (**pdf**) is:

$$f(x) = e^{-\mu}\mu^{x}/x!, x = 0,1,2,...$$

This distribution is useful in determining the probability of obtaining a certain number of successes before a trial begins. For example, you could use this calculation to predict the number of heads that would occur in eight tosses of a coin.

Poisson Cdf (poissCdf())

Computes a cumulative probability for the discrete Poisson distribution with specified mean, $\overline{x}$.

This distribution is useful in determining the probability that a certain number of successes occur between the upper and lower bounds of a trial. For example, you could use this calculation to predict the number of heads displayed between coin toss #3 and toss #8.

Geometric Pdf (geomPdf())

Computes a probability at x, the number of the trial on which the first success occurs, for the discrete geometric distribution with the specified probability of success p. $0 \le p \le 1$ must be true. x can be an integer or a list of integers. The probability density function (pdf) is:

$$f(x) = p(1-p)^{x-1}, x = 1,2,...$$

This distribution is useful in determining the likeliest number of trials before a success is obtained. For example, you could use this calculation to predict the number of coin tosses that would be made before a heads resulted.

Geometric Cdf (geomCdf())

Computes a cumulative geometric probability from lowBound to upBound with the specified probability of success, p.

This distribution is useful in determining the probability associated with the first success occurring during trials 1 through n. For example, you could use this calculation to determine the probability that heads display on toss #1, #2, #3, ..., #n.

Confidence Intervals

Supported Confidence Intervals

The following confidence intervals are available from the Lists & Spreadsheets application. For more information regarding these functions, see the *TI-Nspire™ Reference Guide*.

z Interval (zInterval)

Computes a confidence interval for an unknown population mean, μ, when the population standard deviation, σ, is known. The computed confidence interval depends on the user-specified confidence level.

This test is useful in determining how far from a population mean a sample mean can get before indicating a significant deviation.

t Interval (tInterval)

Computes a confidence interval for an unknown population mean, μ, when the population standard deviation, σ, is unknown. The computed confidence interval depends on the user-specified confidence level.

This test is useful in examining whether the confidence interval associated with a confidence level contains the value assumed in the hypothesis. Like the z Interval, this test helps you determine how far from a population mean a sample mean can get before indicating a significant deviation when the population mean is unknown.

2-Sample z Interval (zInterval_2Samp)

Computes a confidence interval for the difference between two population means ($\mu_1 - \mu_2$) when both population standard deviations (σ_1 and σ_2) are known. The computed confidence interval depends on the user-specified confidence level.

This test is useful in determining if there is statistical significance between the means of two samples from the same population. For example, this test could determine whether there is significance between the mean college entrance test score of female students and the mean of college entrance test score of male students at the same school.

2-Sample t Interval (tInterval_2Samp)

Computes a confidence interval for the difference between two population means ($\mu_1 - \mu_2$) when both population standard deviations (σ_1 and σ_2) are unknown. The computed confidence interval depends on the user-specified confidence level.

This test is useful in determining if there is statistical significance between the means of two samples from the same population. It is used instead of the 2-sample z confidence interval in situations where the population is too large to measure to determine the standard deviation.

1-Prop z Interval (zInterval_1Prop)

Computes a confidence interval for an unknown proportion of successes. It takes as input the count of successes in the sample x and the count of observations in the sample n. The computed confidence interval depends on the user-specified confidence level.

This test is useful in determining the probability of a given number of successes that can be expected for a given number of trials. For instance, casino examiners would use this test to determine if observed payouts for one slot machine demonstrate a consistent pay out rate.

2-Prop z Interval (zInterval_2Prop)

Computes a confidence interval for the difference between the proportion of successes in two populations (p_1–p_2). It takes as input the count of successes in each sample (x_1 and x_2) and the count of observations in each sample (n_1 and n_2). The computed confidence interval depends on the user-specified confidence level.

This test is useful in determining if two rates of success differ because of something other than sampling error and standard deviation. For example, a bettor could use this test to determine if there is an advantage in the long run by playing one game or machine versus playing another game or machine.

Linear Reg t Intervals (LinRegtIntervals)

Computes a linear regression t confidence interval for the slope coefficient b. If the confidence interval contains 0, this is insufficient evidence to indicate that the data exhibits a linear relationship.

Multiple Reg Intervals (MultRegIntervals)

Computes multiple regression prediction confidence interval for the calculated y and a confidence for y.

Stat Tests

Supported Statistical Tests

Hypothesis tests are available from the Lists & Spreadsheets application. For more information regarding these functions, see the *TI-Nspire™ Reference Guide*.

Some of the wizards for Stat Tests display a **Draw** check box. By default, the box is not selected. Selecting the box creates a Data & Statistics work area on the page and plots the results in that work area.

z test (zTest)

Performs a hypothesis test for a single unknown population mean, μ, when the population standard deviation, σ, is known. It tests the null hypothesis H_0: $\mu=\mu_0$ against one of the alternatives below.

- H_a: $\mu\neq\mu_0$
- H_a: $\mu<\mu_0$

- $H_a: \mu > \mu_0$

This test is used for large populations that are normally distributed. The standard deviation must be known.

This test is useful in determining if the difference between a sample mean and a population mean is statistically significant when you know the true deviation for a population.

t test (tTest)

Performs a hypothesis test for a single unknown population mean, μ, when the population standard deviation, σ, is unknown. It tests the null hypothesis $H_0: \mu = \mu_0$ against one of the alternatives below.

- $H_a: \mu \neq \mu_0$
- $H_a: \mu < \mu_0$
- $H_a: \mu > \mu_0$

This test is similar to a z-test, but is used when the population is small and normally distributed. This test is used more frequently than the z-test because small sample populations are more frequently encountered in statistics than are large populations.

This test is useful in determining if two normally distributed populations have equal means, or when you need to determine if a sample mean differs from a population mean significantly and the population standard deviation is unknown.

2-Sample z Test (zTest_2Samp)

Tests the equality of the means of two populations (μ_1 and μ_2) based on independent samples when both population standard deviations (σ_1 and σ_2) are known. The null hypothesis $H_0: \mu_1 = \mu_2$ is tested against one of the alternatives below.

- $H_a: \mu_1 \neq \mu_2$
- $H_a: \mu_1 < \mu_2$
- $H_a: \mu_1 > \mu_2$

2-Sample t Test (tTest_2Samp)

Tests the equality of the means of two populations (μ_1 and μ_2) based on independent samples when neither population standard deviation (σ_1 or σ_2) is known. The null hypothesis $H_0: \mu_1 = \mu_2$ is tested against one of the alternatives below.

- $H_a: \mu_1 \neq \mu_2$
- $H_a: \mu_1 < \mu_2$
- $H_a: \mu_1 > \mu_2$

1-Prop z Test (zTest_1Prop)

Computes a test for an unknown proportion of successes (prop). It takes as input the count of successes in the sample x and the count of observations in the sample n. **1-Prop z Test** tests the null hypothesis H_0: prop=p_0 against one of the alternatives below.

- H_a: prop≠p_0
- H_a: prop<p_0
- H_a: prop>p_0

This test is useful in determining if the probability of the success seen in a sample is significantly different from the probability of the population or if it is due to sampling error, deviation, or other factors.

2-Prop z Test (zTest_2Prop)

Computes a test to compare the proportion of successes (p_1 and p_2) from two populations. It takes as input the count of successes in each sample (x_1 and x_2) and the count of observations in each sample (n_1 and n_2). **2-Prop z Test** tests the null hypothesis H_0: $p_1=p_2$ (using the pooled sample proportion $\hat{p}$) against one of the alternatives below.

- H_a: $p_1 \neq p_2$
- H_a: $p_1<p_2$
- H_a: $p_1>p_2$

This test is useful in determining if the probability of success seen in two samples is equal.

χ^2GOF (χ^2GOF)

Performs a test to confirm that sample data is from a population that conforms to a specified distribution. For example, χ^2 GOF can confirm that the sample data came from a normal distribution.

χ^2 2-way Test ($\chi^2$2way)

Computes a chi-square test for association on the two-way table of counts in the specified *Observed* matrix. The null hypothesis H_0 for a two-way table is: no association exists between row variables and column variables. The alternative hypothesis is: the variables are related.

2-Sample F Test (FTest_2Samp)

Computes an F-test to compare two normal population standard deviations (σ_1 and σ_2). The population means and standard deviations are all unknown. **2-Sample F Test**, which uses the ratio of sample variances $Sx1^2/Sx2^2$, tests the null hypothesis H_0: $\sigma_1=\sigma_2$ against one of the alternatives below.

- H_a: $\sigma_1 \neq \sigma_2$

- H_a: $\sigma_1<\sigma_2$
- H_a: $\sigma_1>\sigma_2$

Below is the definition for the **2-Sample F Test**.

Sx1, *Sx2*	=	Sample standard deviations having n_1-1 and n_2-1 degrees of freedom *df*, respectively.
F	=	F-statistic = $\left(\frac{Sx1}{Sx2}\right)^2$
df(*x*, n_1-1, n_2-1)	=	F*pdf*( ) with degrees of freedom *df*, n_1-1, and n_2-1
p	=	reported *p* value

2-Sample F Test for the alternative hypothesis $\sigma_1 > \sigma_2$.

$$p = \int_F^{\alpha} f(x, n_1 - 1, n_2 - 1)\,dx$$

2-Sample F Test for the alternative hypothesis $\sigma_1 < \sigma_2$.

$$p = \int_0^{F} f(x, n_1 - 1, n_2 - 1)\,dx$$

2-Sample F Test for the alternative hypothesis $\sigma_1 \neq \sigma_2$. Limits must satisfy the following:

$$\frac{p}{2} = \int_0^{Lbnd} f(x, n_1 - 1, n_2 - 1)\,dx = \int_{Ubnd}^{\infty} f(x, n_1 - 1, n_2 - 1)\,dx$$

where: $[Lbnd, Ubnd]$=lower and upper limits

The F-statistic is used as the bound producing the smallest integral. The remaining bound is selected to achieve the preceding integral's equality relationship.

Linear Reg t Test (LinRegtTest)

Computes a linear regression on the given data and a *t* test on the value of slope β and the correlation coefficient ρ for the equation $y=\alpha+\beta x$. It tests the null hypothesis H_0: $\beta=0$ (equivalently, $\rho=0$) against one of the alternatives below.

- H_a: $\beta\neq0$ and $\rho\neq0$
- H_a: $\beta<0$ and $\rho<0$
- H_a: $\beta>0$ and $\rho>0$

Multiple Reg Tests (MultRegTest)

Computes a linear regression on the given data, and provides the F test statistic for linearity.

For more information, see the *TI-Nspire™ Reference Guide*.

ANOVA (ANOVA)

Computes a one-way analysis of variance for comparing the means of 2 to 20 populations. The ANOVA procedure for comparing these means involves analysis of the variation in the sample data. The null hypothesis H_0: $\mu_1=\mu_2=\ldots=\mu_k$ is tested against the alternative H_a: not all $\mu_1 \ldots \mu_k$ are equal.

The ANOVA test is a method of determining if there is a significant difference between the groups as compared to the difference occurring within each group.

This test is useful in determining if the variation of data from sample-to-sample shows a statistically significant influence of some factor other than the variation within the data sets themselves. For example, a box buyer for a shipping firm wants to evaluate three different box manufacturers. He obtains sample boxes from all three suppliers. ANOVA can help him determine if the differences between each sample group are significant as compared to the differences within each sample group.

ANOVA 2-Way (ANOVA2way)

Computes a two-way analysis of variance for comparing the means of two to 20 populations. A summary of results is stored in the *stat.results* variable.

The two-way ANOVA analysis of variance examines the effects of two independent variables and helps to determine if these interact with respect to the dependent variable. (In other words, if the two independent variables do interact, their combined effect can be greater than or less than the impact of either independent variable additively.)

This test is useful in evaluating differences similar to the ANOVA analysis but with the addition of another potential influence. To continue with the ANOVA box example, the two-way ANOVA might examine the influence of box material on the differences seen.

Selecting an Alternative Hypothesis (≠ < >)

Most of the inferential stat editors for the hypothesis tests prompt you to select one of three alternative hypotheses.

- The first is a ≠ alternative hypothesis, such as $\mu \neq \mu 0$ for the **z Test**.
- The second is a **<** alternative hypothesis, such as $\mu 1 < \mu 2$ for the **2-Sample t Test**.
- The third is a **>** alternative hypothesis, such as p1>p2 for the **2-Prop z Test**.

To select an alternative hypothesis, move the cursor to the appropriate alternative, and then press **Enter**.

Selecting the Pooled Option

Pooled (**2-Sample t Test** and **2-Sample t Interval** only) specifies whether the variances are to be pooled for the calculation.

- Select **No** if you do not want the variances pooled. Population variances can be unequal.
- Select **Yes** if you want the variances pooled. Population variances are assumed to be equal.

To select the **Pooled** option, select Yes from the drop-down list.

Working with Function Tables

The Lists & Spreadsheet application lets you show a table of function values for any function in the current problem. You can change the settings for the table, delete columns, add values for multiple functions, and edit the expression that defines a function without leaving the Lists & Spreadsheet application.

Switching to a Table

1. While working in the Lists & Spreadsheet application:

   Windows®: Press **Ctrl**+**T**.

   Mac®: Press ⌘+**T**.

   Handheld: Press ctrl T.

   The Lists & Spreadsheet application disappears and an empty table is displayed with a list of the functions that are available in the problem.

   Note: If you have previously shown a table for a function from the Lists & Spreadsheet application, the table includes that function by default.

2. Choose the name of the function for which you want to display values.

   Values for the function you selected are displayed in the first column of the table.

3. To move through adjacent cells of the table, press ▲ or ▼. Press **Tab** to move from the body of the table (cells) to the top two rows (cells for column names and formulas).

4. To hide the table of values and return to the Lists & Spreadsheet application, repeat Step 1.

Making Changes from a Table

You can change the table of function values using the tools on the **Table** menu.

▶ To remove a column from the table, click any cell and click **Delete Column**.

▶ To display the list of functions, click a cell in a column and click **Choose**. Select a cell in an empty column unless you are replacing values already displayed. Click a function in the list to add its values to the column.

Note: You can also click the drop-down arrow on the top cell of a column to display the list of functions in the problem.

▶ To change the expression that defines a function, click **Edit Expression**. You can also edit the expression directly on the entry line beneath the table.

Note: When you edit the expression for a function, that function automatically changes in the application used to define the function. For example, if you edit a Graphs & Geometry function in the table, the table values and graph of the function are both updated.

▶ To change the default table settings, choose **Edit Table Settings**.

The Table dialog box opens. Press **Tab** to move from field to field and type or select new values for the default table settings:

- **Table Start**: Type the value to use as the first value in the table of values.
- **Table Step**: Type a value for the interval between values.
- **Independent** and **Dependent**: Click the drop-down arrow to choose **Auto** or **Ask** as the method for populating a column with the values of the independent and dependent variables. **Auto** populates the table starting at the defined table start value and displays an independent and dependent value for each step. **Ask** lets you select a cell and press **Enter** to generate a value for a cell.

Notes Application

The Notes application lets you create and share text documents using the TI-Nspire™ handheld and computer software. Use **Notes** to:

- Create study notes to reinforce learning, demonstrate your understanding of classroom concepts, and to review for exams.
- Edit collaboratively by assigning different roles to individuals using your document so that any edits appear in a different text format.
- Create and evaluate math expressions.
- Create correctly formatted chemical formulas and equations.

Adding a Notes Page

▶ To start a new document with a blank Notes page:

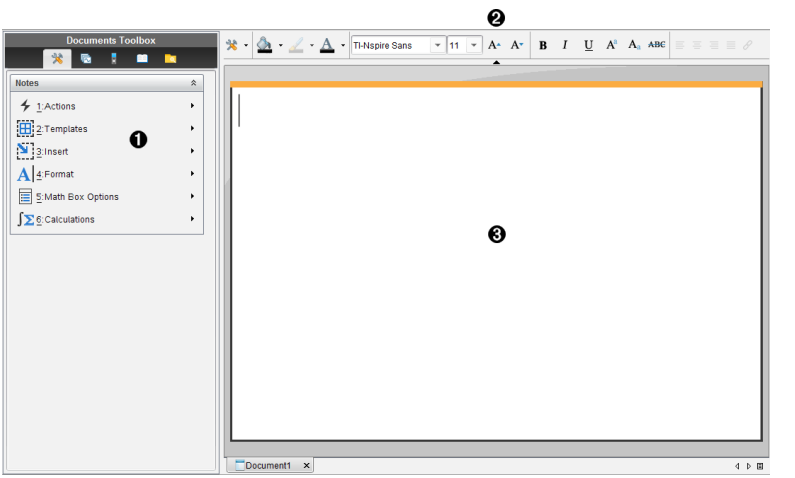
From the main **File** menu, click **New Document**, and then click **Add Notes**.

Handheld: Press [on], and select **Notes** .

▶ To add a Notes page in the current problem of an existing document:

From the toolbar, click **Insert > Notes**.

Handheld: Press [doc] and select **Insert > Notes**.



❶ Notes tools – Available anytime you are in the Notes work area.

❷ Text formatting toolbar -- Lets you change size, color, bold, and other text properties.

❸ Notes work area -- The area where you type and format text.

Using Templates in Notes

Use the options on the Templates menu to select a format for your Notes page.

	Menu Option	Function
2: Templates		
	1: Q&A	Creates a template to enter question and answer text.
	2: Proof	Creates a template to enter statement and reason text.
	3: Default	Lets you type freeform text.
	4:Hide Answer (Q&A)	Toggles to show or hide the Answer in a Q&A format.

Selecting a Template

Complete the following steps to select and apply a template:

1. From the Notes menu, click .
2. From the menu, click the template you want to apply.

   Handheld: From the Notes work area, press menu, and then press ► to display the menu options.

The Notes page is displayed in the format you selected.

Using the Q&A Template

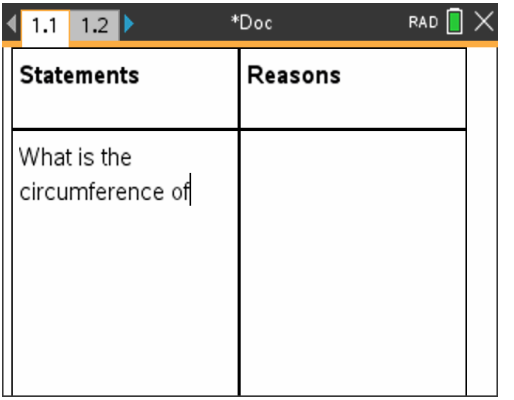
Use the Q&A template to create questions and answers. You can show or hide the answer so you can create questions for review and hide the answers. When you use the document as a study aid, you can verify that your answers are correct.

Press **Tab** to move the text cursor between the **Question** and **Answer** areas of the template.

Using the Proof Template

The proof template provides an outline structure for statements and corresponding reasons.

Press **Tab** to move the text cursor between the **Statements** and **Reasons** areas of the template.



Formatting Text in Notes

Text formatting lets you apply visual properties, such as bold and italic, to your text.

- **Ordinary text**. Apply most combinations of bold, italic, underline, superscript, subscript, and strikethrough formatting. Select font and font size for any character.
- **Text in a math expression box**. Apply formatting and enter math exponents and math subscripts for variable names. Select font and font size. Font size affects all text in the box.
- **Text in a chemical equation box**. Apply formatting. Select font and font size. Font size affects all text in the box. Superscript and subscript are handled automatically.

Selecting Text

▶ Drag from the starting point to the ending point to select the text.

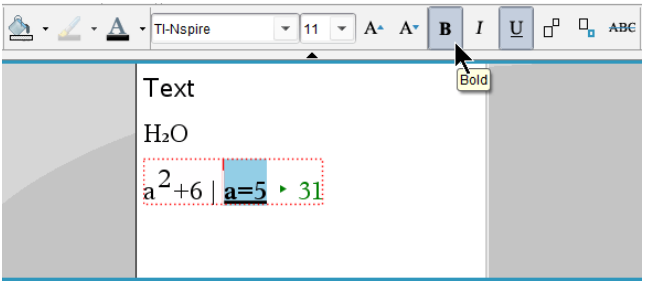
Handheld: If you are using the Q&A or Proof template, press tab to place the cursor in the area containing the text. Use the Touchpad to place the cursor at the start or end of the text to be selected. Hold down ⇧shift, and use the Touchpad to select the text.

Applying a Text Format

1. Select the text that you want to format.
2. On the formatting toolbar, click the formatting icons (such as **B** for bold) to toggle them, or click to select a font and font size.

   Handheld: Click menu, and then select **Format > Format Text**.

   The changes are applied to the text as you make selections.



Note: The toolbar shows only the icons that are applicable to the type of text selected. For example, superscript (A^{a}) and subscript (A_{a}) are shown only for ordinary text.

Using Color in Notes

When working in the Notes application on a desktop, use the (fill color) or the (text color) options on the Documents Workspace toolbar to emphasize words, calculations, and formulas.

You can also apply color to text when working in the Notes application on the TI-Nspire™ CX handheld.

Changing Text Colors

1. Select the text you want to change to another color. You can select a sentence, phrase, word, or a single letter. You can also select a math expression box, a chemical equation box, or individual characters in a calculation, formula, chemical equation, or math template.
2. From the Documents Workspace toolbar, click .

   Handheld: Press doc, and then click **Edit > Text Color**.

   The Text Color palette opens.
3. Click a color to apply it to the selected text.

Applying a Background Color

You can apply a background color to highlight selected characters in ordinary text, text in a math expression, or text in a chemical equation box.

1. Select the text.
2. From the Documents Workspace toolbar, click the arrow next to .

   Handheld: Press doc, and then press **Edit > Fill Color**.

The Fill Color palette opens.

3. Click a color to apply it to the selected text.

Inserting Images

When working in the Notes application on a desktop, use the Images option on the Insert menu to add an image to a Notes page.

Note: The option for inserting an image is not available when working on a handheld. However, you can transfer a file containing an image from your computer to a TI-Nspire™ CX handheld.

1. Click **Insert > Image** from the Documents Toolbar.

   The Insert Image window opens.

2. Navigate to the folder where the image is located.
3. Select the image, and then click **Open** to insert the image into the Notes work area. Valid files types are .jpg, .png, or .bmp.
4. To type text around the image, place the cursor in front of the image or after the image, and then type the text.

Resizing an Image

Complete the following steps to resize an image.

1. Click the image to select it.
2. Move the pointer to the edge of the image.

   The pointer changes to a left-right arrow symbol.

3. Drag the image to make it smaller or larger.

For more information, see *Working with Images*.

Inserting Items on a Notes Page

When working with the Notes application, open the Insert menu to insert a math expression, chemical equation, shape symbol, or a comment.

Menu Name	Menu Option	Function
3: Insert		
	1: Math Box - ctrl M	Lets you insert a math expression.
	2: Chem box	Lets you insert a chemical formula or equation.

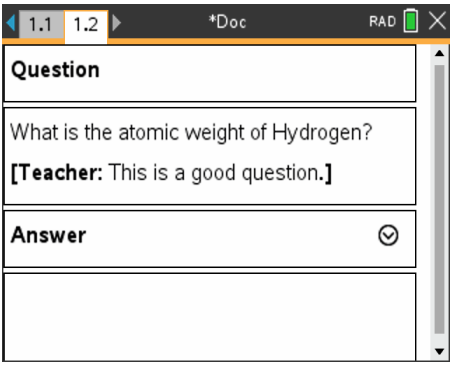
Menu Name	Menu Option	Function
	- ctrl E	
	3: Shape	Marks the selected text as an angle, triangle, circle, line, segment, ray, or vector.
	4: Comment	Lets you type text that is italicized and prefaced with **Teacher** or **Reviewer**.
	5: Slider	Lets you insert a slider.

Inserting Comments in Notes Text

You can insert Teacher or Reviewer comments into a Notes application. Comments are easy to distinguish from the original text.

1. Define the type of comments you are inserting (Teacher or Reviewer):
   - PC: From the **Insert** menu, click **Comment**, and then click **Teacher** or **Reviewer**.
   - Handheld: While in the Notes work area, press menu to display the Notes menu. Press **Insert > Comment**, and then select either **Teacher** or **Reviewer**.
2. Type your text.

   Text that you type appears in italics.

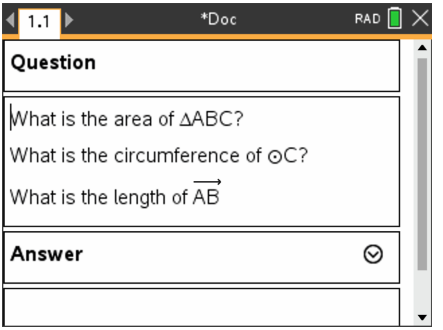


Inserting Geometric Shape Symbols

You can use geometric shape symbols to designate selected text as geometric objects, such as an angle, circle, or line segment.

To insert a shape symbol, position the cursor where you want it, and then do the following:

- PC: From the **Insert** menu, click **Shapes**, and then select the shape to apply.
- Handheld: Press menu to display the Notes menu. On the **Insert** menu, click **Shapes**, and then select the shape to apply.



Entering Math Expressions in Notes Text

You can include math expressions in Notes text, using the same tools as in other TI-Nspire™ applications.

Math expression boxes have attributes that allow you to control how the expression is displayed.

Menu Name	Menu Option	Function
5: Math Box Options		
	1: Math Box Attributes	When a math box is selected, this option opens a dialog box allowing you to customize the math box. You can hide or show input or output, turn off calculation for the box, insert symbols, change display and angle settings, and allow or disallow the wrapping of expressions and the display of warning indicator after they have been dismissed. You can change the attributes of multiple selected math boxes at the same time.
	2: Show Warning Info	Displays a warning indicator after the warning has been dismissed.
	3: Show Error	Displays an error after the error has been dismissed.

Entering an Expression

1. In the Notes work area, position the cursor where you want the expression.
2. From the **Insert** menu, select **Math Box**.
   —or—
   Press **Ctrl + M** (Mac®: Press ⌘+ **M**).

   An empty math expression box is displayed.

3. Type the expression in the box. You can use the Catalog, if necessary, to insert a function, command, symbol, or expression template.
4. To exit the math box, click anywhere outside it.

Evaluating and Approximating Math Expressions

You can evaluate or approximate one or more expressions and display the results. You can also convert selected text and multiple math expression boxes into a single math expression box. Notes automatically updates expressions and any variables used.

Menu Name	Menu Option	Function
1: Actions		
	1: Evaluate - enter	Evaluates the expression.
	2: Approximate ctrl enter	Approximates the expression.
	3: Evaluate and replace	Replaces the selected part of the expression with the result.
	4: Deactivate	Deactivates the current or selected item (box or boxes)
	5: Deactivate All	Deactivates all boxes in the current Notes application.
	6: Activate	Activates the current or selected previously deactivated item.
	7: Activate All	Activates all boxes in the current Notes application.

Evaluating or Approximating an Expression

To evaluate or approximate an expression, place the cursor anywhere in the math expression box and then do the following:

- Windows®: On the **Actions** menu, click **Evaluate** or **Approximate**. You can also use **Enter** to evaluate or **Ctrl + Enter** to approximate.
- Mac®: Press ⌘ **+ Enter** to approximate.
- Handheld: Press menu to display the Notes menu. On the **Actions** menu, select **Evaluate**.

  The result replaces the expression.

Evaluating Part of an Expression

To evaluate part of an expression, select the text or part of the math expression. Then do the following:

▶ On the **Actions** menu, click **Evaluate and Replace**.

Handheld: Press menu to open the Notes menu. Select **Actions**, and then select **Evaluate Selection**.

The result replaces the selected part only.

Breaking Long Calculations

Some calculations may take a long time. Notes indicates that the handheld is performing a long calculation by displaying a busy icon. If a calculation is taking more time than you want to spend, you can end the calculation.

To stop the function or program in progress, do the following:

- Windows®: Hold down the **F12** key and press **Enter** repeatedly.
- Mac®: Hold down the **F5** key and press **Enter** repeatedly.
- Handheld: Hold down the on key and press enter repeatedly.

Showing Warnings and Errors

If a calculation in Notes results in a warning or error, you can view the warning or error again even after you have dismissed the dialog box.

To display a warning or error in Notes after you have dismissed the dialog box, do one of the following:

- Windows®: Right-click and select **Show warning info** or **Show error**.
- Mac®: ⌘ + click and select **Show warning info** or **Show error**.

Note: You can change your settings so that warnings do not appear at all. The showing of warning indicators is controlled by the **Math Box Attributes** dialog box. See *Changing the Attributes of Math Expression Boxes*.

Converting Selected Items to Math Expression Boxes

To convert items to math expression boxes:

1. Select the text, or combination of text and existing math expression box, that you want to evaluate.
2. From the **Actions** menu, click **Convert to Math Expression Box**.

Using Math Actions

Math Actions are available on Notes, Scratchpad, and Calculator pages.

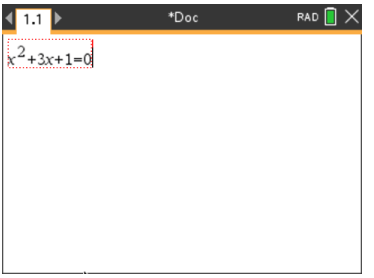
When you display the context menu for a selected expression or equation, the menu may include a **Math Actions** submenu that lists the available actions. Each action might prompt you for any needed parameters.

The specific math actions listed depend on:

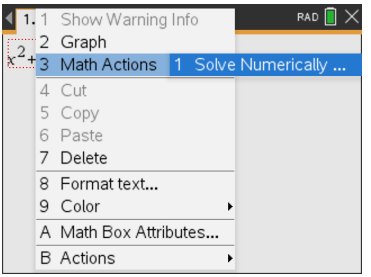
- The type of expression or relation.
- The operating system in use (Numeric, Exact Arithmetic, or CAS).
- Any restrictions imposed by an active Press-to-Test session.

Example of Math Actions in Notes

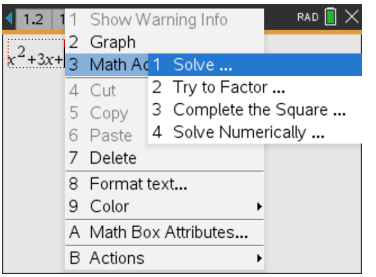
1. Insert a math box, and type the equation $x^2+3x+1=0$, but don't press **Enter** yet.



2. Display the context menu of the equation, and select **Math Actions**.
   Windows®: Right-click the equation.
   Mac®: Hold ⌘, and click the equation.
   Handheld: Point to the equation, and press ctrl menu.



Numeric and Exact Arithmetic OS

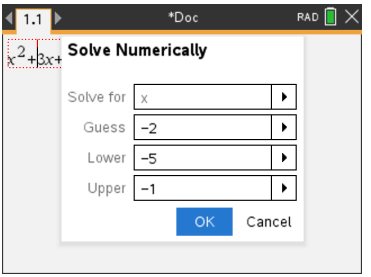


CAS OS

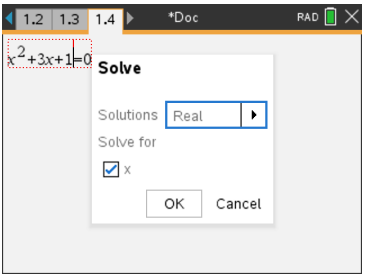
3. Select the action to perform:
   - **Solve Numerically** for Numeric and Exact Arithmetic OS.
   - **Solve** for CAS OS.

   You are prompted to enter parameters. For example, Numeric Solve prompts for the variable of interest, initial guess, lower bound, and upper bound.

4. Type a value for each parameter. When options are available, you can click an arrow to make a selection.

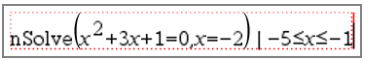


Numeric and Exact Arithmetic OS

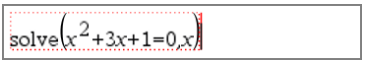


CAS OS

5. Click **OK** to construct the completed expression and place it in the math box.

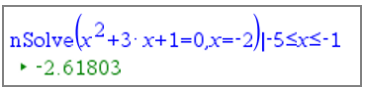


Numeric and Exact Arithmetic OS

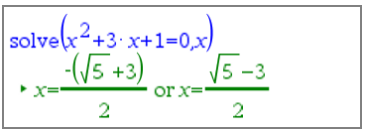


CAS OS

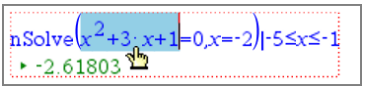
6. Press **Enter** to complete the action.



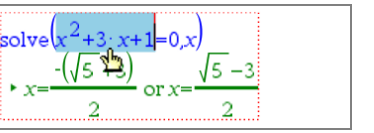
Numeric and Exact Arithmetic OS



7. As a further exploration, drag through the math box to select $x^2+3\cdot x+1$. Do not include the "=0" portion.



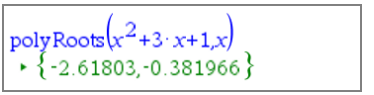
Numeric and Exact Arithmetic OS



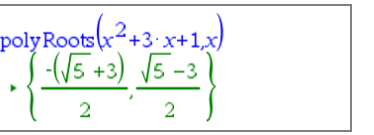
CAS OS

8. Display the context menu for the selected text, select **Math Actions > Find Roots of Polynomial**, and press **Enter** to complete the action.

   The action and its result are shown in a new math box.



Numeric OS



Exact Arithmetic and CAS OS

Tips for Using Math Actions in Notes

- For a previously evaluated expression, click in the expression and then display its context menu.

  When you select an action, it replaces the expression.

- For a displayed result, click in the result and then display its context menu.

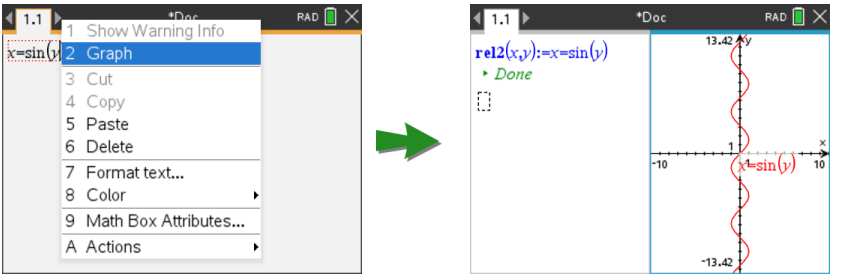
  When you select an action, it appears in a new math box.

- For a portion of an expression or result, select the portion, and then display the context menu.

  When you select an action, it appears in a new math box.

Graphing from Notes and Calculator

You can graph a function or relation directly from its context menu. This feature is available for many functions and relations on Notes, Scratchpad, and Calculator pages.



If page layout options allow, the graph appears on the same page as the function or relation. Otherwise, the graph appears on a separate Graphs page.

The type of graph created depends on:

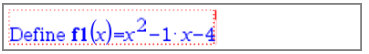
- The type of function or relation.
- Any restrictions imposed by an active Press-to-Test session.

Example of Graphing from Notes

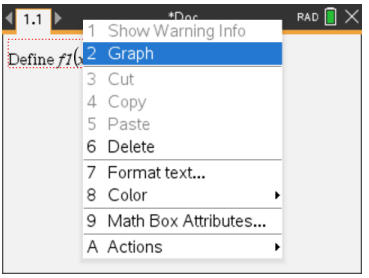
This example uses a Notes page to explore a quadratic function interactively.

1. Insert a math box on a new Notes page, and enter the following function definition:

   Define f1(x)=x²−1·x−4

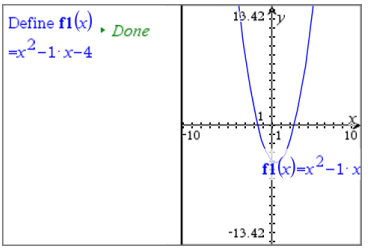
   

2. Display the context menu of the Define statement.
   Windows®: Right-click the statement.
   Mac®: Hold ⌘, and click the statement.
   Handheld: Point to the statement, and press ctrl menu.

3. Select **Graph** from the context menu.

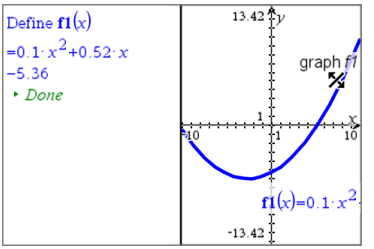
   The graph appears. The graph and the math box are linked so that any adjustment to one affects the other.



4. Explore the relationship between the defined function and its graph:
   - Drag the ends or center of the graph to manipulate it, and observe the changes to the function definition.

     —or—

   - Edit the defined function in the math box, and observe the changes to the graph.



Inserting Chemical Equations in Notes

Chemical equation boxes (chem boxes) make it easy to type chemical formulas and equations, such as $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

As you type in a chem box, most of the formatting work is handled automatically:

- Correct capitalization of most element symbols, such as Ag and Cl, is automatic.
- Leading digits are treated as coefficients and are shown at full size. Numbers that follow an element or a closed parenthesis are converted to subscripts.
- The equals "=" symbol is converted to a yields "→" symbol.

Notes:

- Equations in a chem box cannot be evaluated or balanced.
- Element capitalization may not work in every situation. For example, to enter carbon dioxide, CO_2, you must manually capitalize the O. Otherwise, typing "**co**" would result in"Co," the symbol for cobalt.

Entering a chemical equation

1. In the Notes work area, position the cursor where you want the equation.

2. From the **Insert** menu, select **Chem Box**.
   —or—
   Press **Ctrl + E** (Mac®: Press ⌘ + **E**).

   An empty chemical equation box is displayed.

3. Type the equation in the box. For example, to represent sulphuric acid, type **`h2sO4`**, capitalizing the O manually.

   The chem box automatically formats the text as you type:

   H_2SO_4

4. If you need superscripts for ionic equations, type a caret symbol (**^**) and then the text.

   $2Mn^{2+}$

5. Use parentheses to indicate whether a compound is solid (s), liquid (l), gas (g), or aqueous (aq).

   $2Cl^-(aq) + 2Ag^+(aq) \rightarrow 2AgCl(s)$

6. To exit the chem box, click anywhere outside it.

Deactivating Math Expression Boxes

Calculations are by default activated, which means that results automatically update when you evaluate or approximate an expression. If you don't want results to automatically update, you can deactivate a math expression box, group of boxes, or the entire application.

Deactivating a Box or a Group of Boxes

To deactivate a box or a group of boxes:

1. Select the box or boxes that you want to deactivate.
2. Deactivate the selected box or boxes:
   - Windows®: Click **Actions > Deactivate** (or right-click and then click **Actions > Deactivate**).
   - Mac®: Click **Actions > Deactivate** (or ⌘ + click and then click **Actions > Deactivate**).
   - Handheld: Press menu to open the Notes menu. From the **Actions** menu, select **Deactivate**.

Note: You can manually update a deactivated box or boxes by selecting the box or boxes and using the process described in *Evaluating and Approximating Math Expressions*.

Deactivating All Boxes in the Notes Application

To deactivate all boxes in the Notes application:

▶ With a document open, place your cursor in the Notes application that you want to deactivate and select **Deactivate All**.

- Windows®: Click **Actions > Deactivate All** or right-click and click **Actions > Deactivate All**.
- Mac®: Click **Actions > Deactivate** or ⌘+ click and click **Actions > Deactivate**.
- Handheld: Press menu to display the Notes menu. On the **Actions** menu, click **Deactivate**.

Note: When you use this option in Q&A and Proof templates, Deactivate All deactivates only the math boxes in the current work area.

Changing the Attributes of Math Expression Boxes

You can change attributes in one or more math expression boxes at the same time. Controlling the attributes in math expression boxes allows you to do the following:

- Show or hide the input or output, or prevent calculation in the box.
- Select a symbol separator using Insert Symbol.
- Choose the number of digits to display in the output of a math expression.
- Select angle settings so you can use a combination of radian, degree, and gradian angle measures in the same Notes application.
- Select whether to allow math expressions to wrap.
- Select whether to show or hide warning indicators.

To change the attributes of one or more boxes, do the following:

1. Select the box or boxes that you want to change.
2. On the **Math Box Options** menu, click **Math Box Attributes**.
3. Use the menus or selection boxes to make your selections.
4. Click **OK** to save or **Cancel** to abandon the change.

Note: Math expression boxes recalculate automatically after you have made attribute changes and saved the changes.

Undoing Changes to Math Expression Boxes

▶ To undo changes you have made to a math expression box, press **Ctrl+Z**.

Using Calculations in Notes

In the Notes application, the options on the Calculations menu enable you to perform calculations. The calculations are described in the following table.

Important Information to Know

- Notes does not support editing programs. Use Program Editor instead.
- Notes does not support executing Lock or Unlock commands. Use Calculator instead.
- Notes does not display intermediate results obtained using the "Disp" command. Use Calculator instead.
- Notes does not support user-defined dialog boxes obtained using the "Request," "RequestStr," or "Text" commands. Use Calculator instead.
- Notes does not support the execution of multiple statistics commands that produce stat. variables.

Menu Name	Menu Option	Function
6: Calculations		
	1: Define Variables	Define a variable in a Note using the Calculator application.
	2: Number	Use tools from the Calculator Number menu, including Convert to Decimal, Approximate to Fraction, Factor, Least Common Multiple, Greatest Common Divisor, Remainder, Fraction Tools, Number Tools, and Complex Number Tools.
	3: Algebra	Use tools from the Calculator Algebra menu, including Numerical Solve, Solve System of Linear Equations, Polynomial Tools.
	4: Calculus	Use tools from the Calculus menu including Numerical Derivative at a Point, Numerical Definite Integral, Sum, Product, Numerical Function Minimum, and Numerical Function Maximum.
	3 (CAS): Algebra	Use tools from the Calculator Algebra menu, including Solve, Factor, Expand, Zeros, Numerical Solve, Solve System of Equations, Polynomial Tools, Fraction Tools, Convert Expressions, Trigonometry, Complex, and Extract.
	4 (CAS): Calculus	Use tools from the Calculus menu including Derivative, Derivative at a Point, Integral, Limit, Sum, Product,

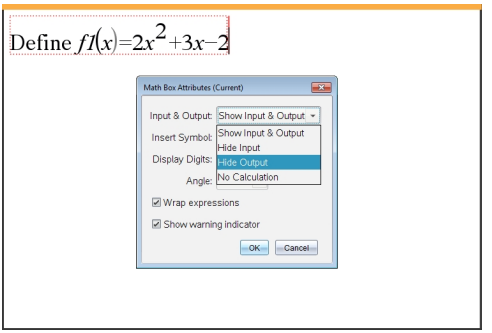
Menu Name	Menu Option	Function
		Function Minimum, Function Maximum, Tangent Line, Normal Line, Arc Length, Series, Differential Equation Solver, Implicit Differentiation, and Numerical Calculations
	 5: Probability	Use tools from the Calculator Probability menu, including Factorial, Permutations, Combinations, Random, and Distributions.
	 6: Statistics	Use tools from the Calculator Statistics menu, including Stat Calculations, Stat Results, List Math, List Operations, and others.
	 7: Matrix & Vector	Use tools from the Calculator Matrix & Vector menu, including Create, Transpose, Determinant, Row-Echelon Form, Reduced Row-Echelon Form, Simultaneous, and others.
	 8: Finance	Use tools from the Calculator Finance menu, including Finance Solver, TVM Functions, Amortization, Cash Flows, Interest Conversions, and Days between Dates.
	Note: For more information, see the Calculator chapter.	

Exploring Notes with Examples

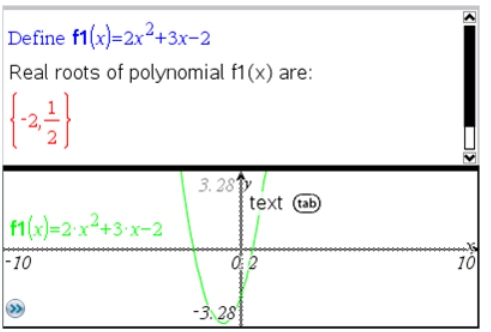
This section shows you how the Notes application works with other applications to automatically update results.

Example #1: Using Notes to Explore Roots of a Quadratic Function

1. Open a new document and select the Notes application.
2. Define a function in a math box, evaluate, and hide the output using the Math Box attributes.

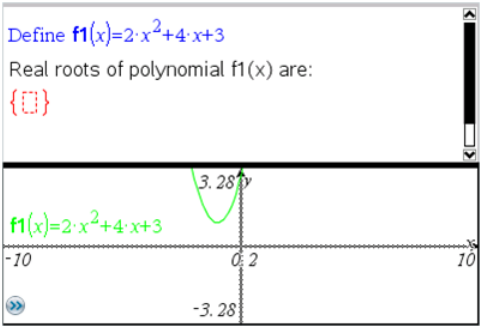


3. Type some more text; for example: **`Real Roots of f1(x) are:`**
4. In a new math box, type: **`polyRoots(f1(x),x)`**.
5. Press **Enter** and hide the input of this math box by using the Math Box attributes dialog box.
6. Use the Page Layout toolbar icon to select the split layout.



7. Add the Graph application and plot $f1(x)$.

   See how the roots of $f1$ change when the function is modified in Graph.



Example #2: Using Notes to Explore Data Sampling

This example shows how to create a sampling distribution of sample means drawn from a given population. We will be able to watch the sampling distribution take shape for a given sample size and describe its characteristics. You can change the population and the sample size.

1. Set up the population and the sample size.
   a) Type **`Create sample data:`**
   b) Insert a math expression box and define the population. For example, type **`population:=seq(n,n,1,50)`**.
   c) Press **Enter** and hide the output using the Math Expression Box Attributes dialog box.
   d) Insert a math expression box and define the sample size. For example, type **`size:=5`**.
   e) Press **Enter** and hide the output using the Math Expression Box Attributes dialog box.
2. Set up the initialization.
   a) Type **`Start taking samples:`**
   b) Insert a math expression box and set the initial values for the number of samples (*num*) and the list of sample means (*sampmeans*). Type:

      `num:=0:sampmeans:={}`

   c) Press **Enter** and hide the output using the Math Expression Box Attributes dialog box.

d) Deactivate the math expression box using **Actions > Deactivate**. The deactivation will prevent the content of that math box from being overwritten when the values for num and sampmeans change. The deactivated math box will be shown with the light color background.

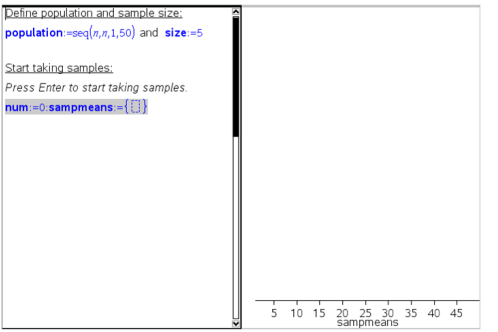
3. Set up Data & Statistics for the sampling.

   a) Change the page layout and insert Data & Statistics.

   b) Click on the horizontal axis and add sampmeans list.

   c) Change the window setting: XMins=1 and XMax = 50.

   d) You can also set up the plot of the mean of sample means using **Analyze > Plot Value**.



4. Enter the instructions to add data.

   a) Type **`Create new samples:`**

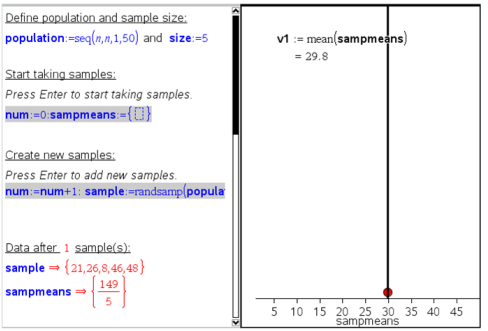
   b) Insert a math expression to define the sample (sample) and update the number of samples and the list of sample means. Type:

```
num:=num+1:sample:=randsamp(population,size):
sampmeans:=augment(sampmeans,{mean(sample)})
```

   c) Press **Enter**, hide the output, and turn off the expression wrapping using the Math Expression Box Attributes dialog box.

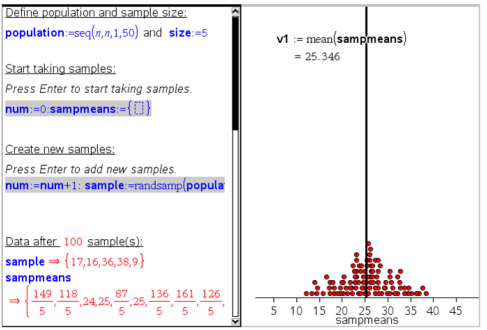
   d) Deactivate the math expression box using **Actions > Deactivate** to prevent the contents of the math box from changing when *num* and *sampmeans* values are reinitialized.

   e) Create math expression boxes that display the current number of experiments (*num*), sample (*sample*), and the list of sample means (*sampmeans*).

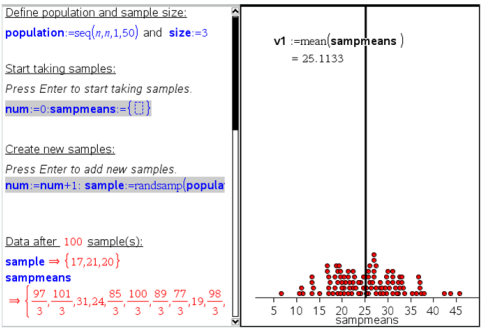


5. Now you are ready to explore. Add more samples by simply pressing **Enter** when you are in the math expression box in the "Create new samples" section.

   Note: You can also automate the sampling process by using a **For ... EndFor** loop.



   You can also change the sample size and restart the sampling.



Widgets

All work that you create and save using TI-Nspire™ applications is stored as a document, which you can share with others using TI-Nspire™ software, a TI-Nspire™ CX II handheld, or the TI-Nspire™ App for iPad®. You save these TI-Nspire™ documents as .tns files.

A Widget is a .tns document that is stored in your MyWidgets folder.

You can use Widgets to:

- Easily access text files
- Insert and run scripts (such as the pre-loaded widget example: Stopwatch.tns)
- Quickly insert a saved problem into a document

When you add a Widget, TI-Inspire™ CX extracts only the first page of the selected .tns file, and inserts it into your open document.

Creating a Widget

A document is regarded as a Widget when it is saved or copied to the designated MyWidgets folder. The default location is:

- Windows®: My Documents\TI-Nspire\MyWidgets.
- Mac®: Documents/TI-Nspire/MyWidgets.
- Handheld: MyWidgets
- TI-Nspire™ App for iPad® and TI-Nspire™ CAS App for iPad®: MyWidgets

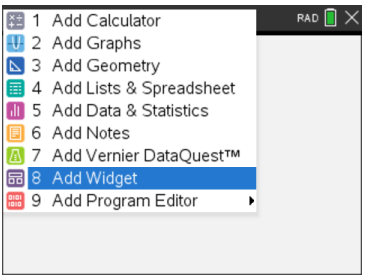
If the MyWidget folder has been inadvertently deleted, you must create it before attempting to use a Widget.

Note: When you add a Widget, TI-Inspire™ CX extracts only the first page of the selected .tns file, and inserts it into your open document.

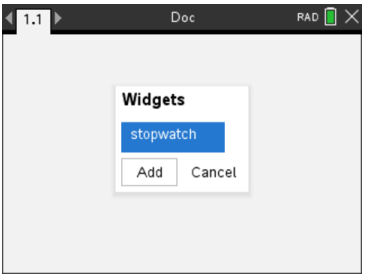
Adding a Widget

Adding a Widget to a New Document

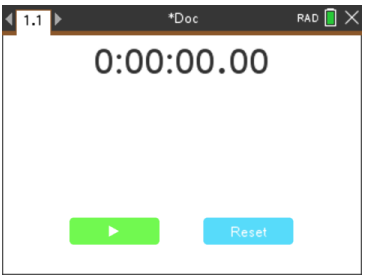
1. Open a new document.
2. Click **Add Widget**.



3. Scroll to select a .tns file from the box.
4. Click **Add**.

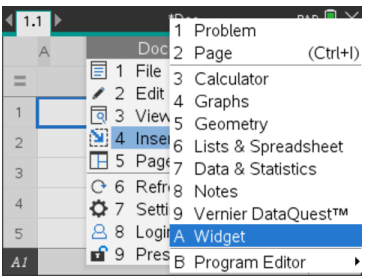


Note: Stopwatch is a preloaded .tns file. Any saved .tns file will show up in this list.

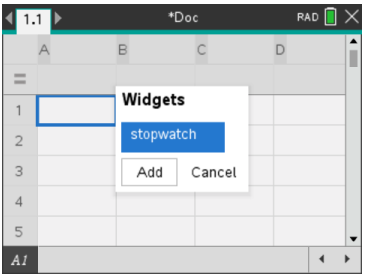


Adding a Widget to an Existing Document

1. Click **Doc > Insert > Widget**.



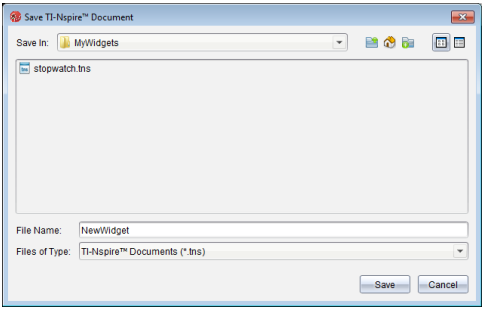
2. Click **Add**.



Note: You can also add a Widget to a new or existing document using the **Insert** menu.

Saving a Widget

1. Click  .
2. Navigate to **MyDocuments > MyWidgets**.
3. Type in a name for your Widget.



4. Click **Save**.

General Information

Online Help

education.ti.com/eguide

Select your country for more product information.

Contact TI Support

education.ti.com/ti-cares

Select your country for technical and other support resources.

Service and Warranty Information

education.ti.com/warranty

Select your country for information about the length and terms of the warranty or about product service.

Limited Warranty. This warranty does not affect your statutory rights.

Texas Instruments Incorporated

12500 TI Blvd.

Dallas, TX 75243

Precautions for Rechargeable Batteries

- Do not expose batteries to temperatures above 140°F (60°C).
- Do not disassemble or mistreat batteries.
- Use only the charger recommended for the cell or battery, or the one that was provided with the original equipment.
- TI recommends that you use the USB cable included with this calculator. If you choose to use a third-party power adapter with the TI-supplied USB cable, you should use an adapter that meets applicable safety and operational standards and certifications, including UL and CE certifications.

Take these precautions when replacing rechargeable batteries:

- Replace only with a TI approved battery.
- Remove the cell or battery from the charger or alternating current adapter when not in use or being charged.
- Use of the battery in other devices may result in personal injury or damage to equipment or property.
- Do not mix brands (or types within brands) of batteries. There is a risk of explosion if a battery is replaced by the wrong type.

Disposing of Batteries

Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries according to local regulations.

Index

C

D

E

F

G

H

I

K

L

M

Q

R

S

T

U