TEXAS INSTRUMENTS

TI-nspire™

math and science learning handheld

Part 2

Important Information

Contents

Introduction

The TI-Nspire™ math and science learning handheld

This guidebook provides information about a powerful, advanced learning handheld available from Texas Instruments: the TI-Nspire™ handheld.

Your learning handheld comes equipped with a variety of pre-installed software applications that have features relevant to many different subjects and curriculums.

Extend the reach of your TI-Nspire™ handheld with accessories, such as the TI-Nspire™ computer software for math and science, TI-Nspire™ ViewScreen™ Panel, TI-Nspire™ Connections Cradle and TI-Nspire™ Computer Link Software.

How to use this guidebook

This guidebook is intended to supplement the printed guidebook that accompanied your TI-Nspire™ handheld.

The chapters in this guidebook include:

TI-Nspire™ handheld Connectivity - Provides instruction for connecting and transferring data and files between two TI-Nspire™ handhelds.

Memory Management - Includes instruction for checking memory on your handheld, and freeing memory if you need additional space.

Using the TI-Nspire™ Computer Link Software - Provides instruction for transferring documents between handhelds, capturing images from your handheld, backing up contents and updating the Operating System (OS) on your TI-Nspire™ handheld.

Data Collection - Provides detailed steps for collecting experimental information from a sensor and automatically display it in a table and/or graph for analysis.

Using Graphs & Geometry - Provides detailed instruction for using the Graphs & Geometry application.

Using Calculator -Provides detailed instruction for using the Calculator application.

Using Lists & Spreadsheet -Provides detailed instruction for using the Lists & Spreadsheet application.

Using Data & Statistics-Provides detailed instruction for using the Data & Statistics application.

Using Notes - Provides detailed instruction for using the Notes application.

Appendix: Technical Reference - Includes error messages and other technical information.

Service and Warranty Information - Includes service and warranty information and contact information for technical support.

Where to find more information

Additional product information is available in printed guidebook that accompanied your TI-Nspire™ handheld. An electronic version of the printed guidebook for using the TI-Nspire™ handheld is included on the CD-ROM that came with your learning handheld. This guidebook is also available online as a free download at education.ti.com/guides.

Transferring Files

Connecting two handhelds

This chapter describes how to connect one TI-Nspire™ handheld to another, and how to transfer files between them. The TI-Nspire™ handheld has a USB port which allows it to communicate with another TI-Nspire™ handheld.

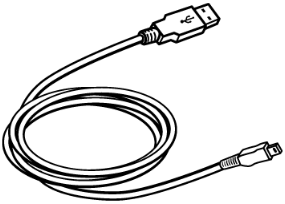
When the TI-Nspire™ handheld is using TI-Nspire™ TI-84 Plus keypad, it can connect with another TI-Nspire™ handheld using the TI-Nspire™ TI-84 Plus keypad or a TI-84 Plus using the USB port or the I/O port.

Using connection cables

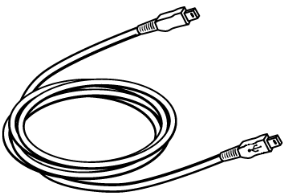
Your TI-Nspire™ handheld comes with connection cables that allow you to share files with both a computer and another handheld.

USB cables

You can use USB cables to connect two TI-Nspire handhelds, to connect a TI-Nspire handheld to a computer, or to connect one TI-Nspire™ handheld using TI-Nspire™ TI-84 Plus keypad to another.



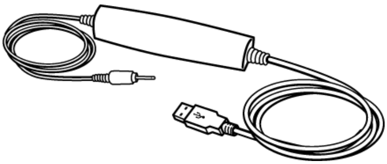
TI-Nspire™ USB connection cable to connect handheld to a computer using TI-Nspire Computer Link software.



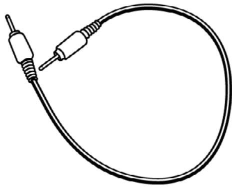
TI-Nspire™ handheld mini-USB cable to connect two TI-Nspire handhelds

TI-84 Plus Mode cables

If you already have TI-84 Plus handhelds and use the I/O port for connectivity, you can use the same cables to connect to a TI-Nspire handheld using the 84 keypad.



USB connection cable to connect handheld to a computer using TI Connect software.



TI-84 Plus I/O device-to-device connection cable

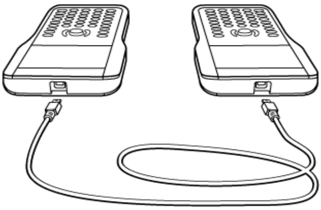
Connecting two TI-Nspire™ handhelds with the USB unit-to-unit cable

You can connect two handhelds this way as long as both handhelds are using the same keypad. You cannot connect a handheld using the TI-Nspire™ TI-84 Plus keypad to a handheld using the native TI-Nspire keypad.

Note: Use the I/O cable to connect a handheld using the TI-Nspire™ TI-84 Plus keypad to a TI-84 Plus.

The TI-Nspire™ handheld USB A port is located at the center of the top of the TI-Nspire handheld.

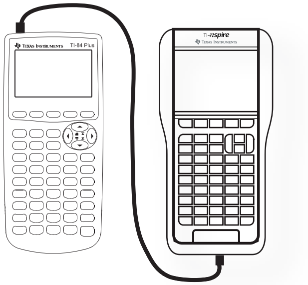
1. Firmly insert either end of the USB unit-to-unit cable into the USB A port.
2. Insert the other end of the cable into the receiving unit's USB A port.



Connecting a TI-Nspire™ with TI-84 Plus Keypad to a TI-84 Plus handheld using the I/O unit-to-unit cable

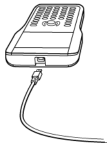
The TI-Nspire™ TI-84 Plus keypad I/O link port is located at the bottom edge of the keypad. The TI-84 Plus I/O link port is located at the top left edge of the graphing calculator.

1. Firmly insert either end of the I/O unit-to-unit cable into the port.
2. Insert the other end of the cable into the other graphing calculator's I/O 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.

Backing up files to a computer

Use the TI-Nspire™ Computer Link Software or the TI Connect software to back up the contents of your handheld to a computer. TI-Nspire™ Computer Link Software and TI Connect software are available on the product CD that came with your handheld.

Transferring documents

Rules for transferring files

- You can transfer documents and Operating System (OS) files.
- If a document with the same name as the one you are sending already exists on the receiving TI-Nspire™ 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 TI-Nspire™ handheld, it would be renamed Mydata(2).

Both the sending and receiving units 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 unit and the file names contain 255 characters, then the name of the transmitted file will be truncated to enable the software to follow the renaming scheme described in the previous bullet.
- All variables associated with the document being transmitted are transfered with the document.
- Transmissions will time out after 30 seconds.

Sending a document

1. Open My Documents.

   Press ⌂ 7.

2. Press the ▲ and ▼ keys on the NavPad to highlight the document you want to send.
3. Select **Send** from the My Documents menu.

   Press ctrl ⌂ 1 5.

4. The file transfer begins. A progress bar displays to allow you to follow the transfer. There is also a cancel button on the Sending... dialog to enable you to cancel the transmission while it in progress.

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

Receiving a document

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

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

Canceling a transfer

1. To cancel a transmission in-progress, press Cancel on the dialog of the sending unit. The user of either unit can also press esc.
2. A link transmission error message displays.

3. Press esc or enter to cancel the transmission error message.

Common error and notification messages

Shown on:	**Message and Description**
Sending unit	"Transfer failed. Check cable and try again." OK This message displays if a cable is not attached to the sending unit's link port. Remove and then reinsert the cable and try the document transmission again. Press esc or enter to cancel the transmission message. **Note:** The sending unit may not always display this message. Instead, it may remain BUSY until you cancel the transmission.
Sending unit	"Receiver does not have enough storage space for file transfer." OK This message displays when the receiving unit does not have enough memory to accept the file being transmitted. The user of the receiving unit must free space in order to obtain the new file. To do this: • Delete unneeded files. • Store files on a computer for later retrieval, then delete them from the TI-Nspire™ handheld.

Shown on:	Message and Description
Sending unit	"<folder>/<filename> transferred as <folder>/<filename(#)." This message displays at the end of a successful transfer when the file had to be renamed because a file already exists on the receiving unit 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 unit	"<folder>/<filename> transferred as <folder>/<new filename>." This message displays when a new folder is created on the receiving unit to contain the transmitted document.
Receiving unit	"<folder>/<filename(x)> received." This message displays if the receiving unit has a document with the same name as the document being sent.

Shown on:	Message and Description
Receiving unit	"<new folder>/<new filename> received." This message displays when a new folder has been created to contain the transmitted document.
Receiving unit	"Transfer failed. Check cable and try again." OK This message displays if the cable is not correctly attached to the receiving unit's link port. Remove the cable then reattach it and try the transmission again. Press esc or enter to cancel the transmission message.

Upgrading the Operating System

You can upgrade the OS on your TI-Nspire™ handheld using your computer and TI-Nspire™ Computer Link Software. You can also transfer the OS from one unit to another.

OS upgrade operations do not delete user documents. If there is not enough room on the receiving handheld for the upgrade, the sending handheld is notified. The only time documents can be 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 your important documents and folders before installing an updated operating system.

See the important information concerning batteries before performing an OS upgrade.

Important Operating System download information

It is always a good practice to install new batteries before beginning an OS download.

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 the batteries with new batteries before downloading.

Where to get Operating System upgrades

For up-to-date information about available OS upgrades, check the Texas Instruments Web site at http://education.ti.com.

You can download an OS upgrade from the Texas Instruments Web site to a computer, and use a USB computer cable to install the OS on your TI-Nspire™ handheld.

For complete information, refer to the instructions in the chapter on TI-Nspire™ Computer Link Software.

Transferring the Operating System

To transfer the OS from unit to unit:

1. Connect the two units. (For details, see the connection instructions at the beginning of this chapter.) Any open documents on the receiving unit should be closed before the transfer begins.
2. On the sending unit, open My Documents.

   Press [home] [7].

3. From the menu, select **Send OS**.

   Press menu 9.

4. On the receiving unit, the message, "You are receiving an OS Upgrade. Unsaved changes will be lost. Would you like to continue?" displays along with Yes and No response buttons. Select Yes to receive the OS upgrade.

   Notes:

   - If Yes is not selected within 30 seconds, the unit 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 unit with an open, unsaved document will cause the loss of that data.

5. While the upgrade is in progress, the receiving unit displays, "Receiving OS. Do not unplug cable." The sending unit displays, "Sending OS. Do not unplug cable."

6. After the transfer completes, the sending unit receives a completion message and can unhook the cable. On the receiving unit, the OS must be installed. This happens automatically. During the installation process, the receiving unit displays the message, "Installing OS <*version number*>."

7. When the installation completes, the unit displays the following message, "OS <*version number*> has been installed. Handheld will now restart." The restart is initiated. If the sending unit is still attached to the cable, the successful transmission message remains displayed on that unit's screen.

Important:

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

OS Upgrade Messages

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

Shown on:	Message and Description
Sending unit	"Receiver does not have enough storage space. Make <xxxK> available." This message displays when the receiving unit does not have enough memory available for the new OS. The space requirement is shown so you know how much memory must be cleared for the new operating system. Files can be moved to a computer for storage to free the necessary space.
Sending unit	"Receiver must change batteries before upgrading the OS." This message displays when the batteries in the receiving unit need to be replaced. Send the OS Upgrade once the batteries are replaced.
Sending unit	"Receiver has a newer OS and cannot load this OS." OK This message displays when the receiving unit has a newer OS version that the one being transmitted. You cannot downgrade an OS.

Shown on:	Message and Description
Sending unit	"Upgrade not accepted by receiver." OK This message displays when the receiving unit refuses the upgrade.
Sending unit	"OS has been transferred. You can now unplug." OK This message displays when the tranfer is completed and it is safe for the sending unit to unplug the cable.
Sending unit	"Sending OS. Do not unplug cable." This message, along with a progress bar, displays while the OS Upgrade is being transferred.
Both units	"Transfer failed. Check cable and try again." OK The sending and/or receiving unit is not properly connected. Reinsert the cable into each handheld, then try the transmission again.

Shown on:	Message and Description
Receiving unit	"You are receiving an OS Upgrade. Unsaved changes will be lost. Would you like to continue?" Yes No This message displays when an OS Upgrade is about to begin. If you do not select Yes within 30 seconds, the system automatically responds with No.
Receiving unit	"Receiving OS. Do not unplug cable." This message, along with a progress bar, displays while the OS Upgrade is being transferred.
Receiving unit	"Installing OS." This message displays once the transfer is completed. It is shown to keep you informed of the unit's status.
Receiving unit	"OS has been installed. Handheld will restart." OK This information message displays briefly before the unit automatically reboots.

Shown on:	Message and Description
Receiving unit	"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 unit will reboot. After the reboot, reinstall the OS Upgrade.

Memory and File Management

Checking available memory

The Handheld Status screen shows the amount of memory (in bytes) used by all documents and variables on your TI-Nspire™ handheld. The Handheld Status screen displays the following information:

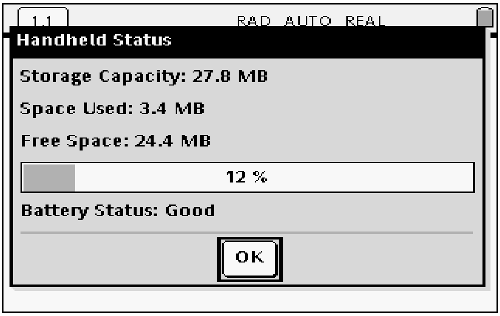
- Storage Capacity
- Space Used
- Free Space
- Battery Status

Displaying the Handheld Status screen

▶ Select **Handheld Status** from the Home menu.

Press 8 3

The Handheld Status window displays.



Freeing Memory

If you have insufficient memory to store documents on your handheld, you must free memory to create the space you need. To free memory, you must delete documents and/or folders from memory. If you wish to keep the documents and folders for use later, you can back them up to another handheld or to a computer.

Deleting items from memory

If you have documents stored on your TI-Nspire™ handheld that you no longer need, you can delete them from memory to create additional space.

Before you delete documents from memory, consider restoring sufficient available memory by copying files to another handheld.

1. Open My Documents.

   Press [home] [7].

2. Press ▲ or ▼ to select the folder or document you want to delete.

3. Select Delete.

   Press [ctrl] [home] [2] [6].

   The folder/document is permanently removed from the handheld.

Backing up files to another handheld

To back up files to another TI-Nspire™ handheld, follow the steps below. Complete instructions for connecting two handhelds are provided in the Connectivity chapter.

1. Connect the two handhelds using the USB-to-USB Connectivity Cable.

2. Open My Documents on the sending unit.

   Press [home] [7].

3. Press the ▲ and ▼ keys to highlight the document you want to send.

4. Select **Send** from the Document menu.

   Press [ctrl] [home] [1] [5].

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

Backing up files to a computer

Use the TI-Nspire™ Computer Link Software software to back up the contents of your handheld to a computer. TI-Nspire™ Computer Link Software is available on the product CD that came with your handheld.

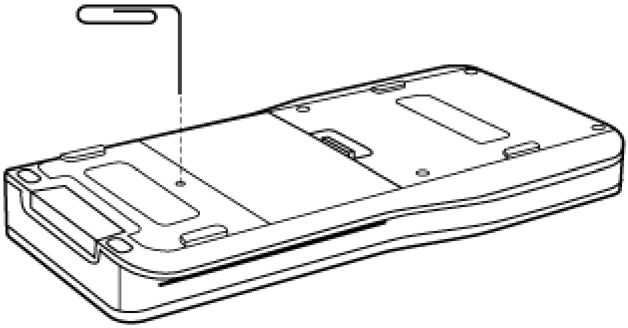
Resetting the memory

The Reset button on the underside of the handheld resets all memory. When resetting all memory on the TI-Nspire™ handheld, RAM and Flash memory is restored to factory settings. All files will be deleted. All system variables are reset to default settings.

Caution: Before you reset all memory, consider restoring sufficient available memory by deleting only selected data.

To reset all memory on the handheld, follow these steps.

1. Use a paper clip or ball point pen to press the reset button on the underside of the handheld.



2. Hold for three seconds, and release.

   Handheld memory is cleared.

When you clear memory, the contrast cometimes changes. If the screen is faded or blank, adjust the contrast by pressing ctrl + or ctrl −.

Using the TI-Nspire™ Computer Link Software

Getting started with TI-Nspire™ Computer Link Software

The TI-Nspire™ Computer Link Software lets you:

- Transfer documents between your computer and a TI-Nspire™ handheld.
- Capture images from a TI-Nspire™ handheld screen and use them in TI-Nspire™ documents and computer documents.
- Make a backup of a handheld's documents as a single file on your computer and later restore the documents.
- Update the operating system (OS) software on a TI-Nspire™ handheld.

Opening the TI-Nspire™ Computer Link Software

1. Make sure you have connected a TI-Nspire™ handheld to your computer.

   Note: The TI-Nspire™ Computer Link Software works with the TI-Nspire™ handheld only. You cannot use it to communicate with other TI handhelds, such as a TI-92 Plus. To communicate with those handhelds, use the TI Connect™ software (version 1.6 or later) instead of TI-Nspire™ Computer Link Software.

2. Double-click the TI-Nspire™ Computer Link Software icon  on the desktop.

   The software displays a list of connected handhelds and lets you select one.

   Note: You can communicate with only one handheld at a time.

3. If multiple handhelds are connected, click the handheld to which you want to connect.
4. Click **Select**.

   TI-Nspire™ Computer Link Software displays the Explorer tab.

Selecting among multiple handhelds

You can switch to a different handheld anytime you are using TI-Nspire™ Computer Link Software.

1. Connect the handheld to the computer.

2. Click at the lower right corner of the TI-Nspire™ Computer Link Software window.

3. Click the handheld name, and then click **Select**.

Exploring handheld contents

The Explorer tab in the TI-Nspire™ Computer Link Software lets you view the contents of a connected handheld and transfer (copy) documents between your computer and the handheld. You can also rename and delete handheld documents.

❶ Column headings – In the detail view, click a heading to sort the list. Click again to reverse the order.

❷ Files residing in the selected computer folder

❸ Split bar – Drag up and down to show more or fewer files.

❹ Documents residing in the selected handheld folder

Selecting the view format

Note: You can click the **Refresh** button anytime to refresh the file and folder lists.

- Click **View > Detail View** or click to view details of the files and to sort the list.
- Click **View > List View** or click to view a list of only the file names.
- Click **View > Show Folder View** to show the structure of computer and handheld folders in a separate pane on the left.
- Click **View > Hide Folder View** to hide the folder structure.

Viewing the contents of a handheld

1. If the Explorer is not visible, click the Explorer tab.

2. In the folder view, click any folder to show its contents in the right list.

Before copying documents or folders to a handheld

- TI-Nspire™ Computer Link Software allows only TI-Nspire™ handheld documents to be copied to a handheld. If you inadvertently try to copy other types of files, or a folder containing other types of files, TI-Nspire™ Computer Link Software notifies you and cancels the copy operation.
- Only subfolders can reside within the Documents folder on the handheld. You can copy files into those subfolders but not directly into the Documents folder.
- When you copy a folder to the handheld, you must copy it to the Documents folder. You cannot copy it to a subfolder.
- You can drag handheld files and folders only to locations within the TI-Nspire™ Computer Link Software application window. You cannot drag them outside the window.

Copying documents by dragging

You can drag the mouse to copy documents between a handheld and the computer or between two folders on the computer.

1. Click the document that you want to copy.

   Note: You can select multiple documents by holding down the **Ctrl** key and clicking each document.

2. Drag the selection, and drop it on the desired destination.

   The selected items are copied to the destination.

   Note: If a document of the same name already exists at the destination, you are asked if you want to replace it.

Copying folders by dragging

You can drag to copy folders between a handheld and the computer.

1. Click the folder that you want to copy.

   Note: You can select multiple folders by holding down the **Ctrl** key and clicking each folder.

2. Drag the selection, and drop it on the desired destination.

   The selected items are copied to the destination.

   Note: If a folder or document of the same name already exists at the destination, you are asked if you want to replace it.

Copying documents and folders by pasting

You can use the Clipboard to copy documents and folders. If you want to move an item instead, copy it and then delete the original.

1. Click the document or folder to be copied.

   Note: You can select multiple items by holding down the **Ctrl** key and clicking each item.

2. Click **Edit > Copy** to copy the selected items to the Clipboard.
3. Click a folder to select it as the destination.
4. Click **Edit > Paste**.

   Explorer copies the items to the destination folder.

Note: If the destination already contains a document with the same name as the one you are copying, you can choose to either replace the existing document or cancel.

Canceling a transfer in progress

As long as the File Transfer window is displayed, you can cancel a transfer. Only the files that have not already been transferred are canceled.

▶ In the File Transfer window, click **Cancel**.

Creating a new folder on the handheld

You can create a new folder within the Documents folder on the handheld. You cannot create a folder within a subfolder on the handheld.

1. Click the handheld name in the TI-Nspire™ File Browser.
2. Click **File > New folder**.

   TI-Nspire™ Computer Link Software creates a folder named New Folder and selects the name so you can edit it.

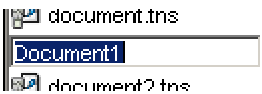
3. Type a name for the new folder and press **Enter**.

Renaming documents and folders on a handheld

Note: TI-Nspire™ Computer Link Software does not let you change a document's file name extension.

1. Click the document or folder name and then click **File > Rename**.

   A border appears around the name to show that you can edit it.



2. Type the new name and press **Enter**.

Deleting documents on a handheld

When you delete a document, it is permanently deleted and cannot be recovered.

▶ Click the document name and then click **File > Delete**.

Before deleting the document, Explorer asks you to confirm that you want to delete it.

Note:

- You can select multiple documents to delete by holding down the **Ctrl** key and clicking each document. When you click **Delete**, Explorer deletes all the selected documents.
- You cannot delete files on the computer.

Deleting a folder on a handheld

When you delete a folder, the folder and all documents within it are permanently deleted and cannot be recovered.

▶ Click the folder name and then click **File > Delete**.

Before deleting the folder, Explorer asks you to confirm that you want to delete it.

Note:

- You can select multiple folders to delete by holding down the **Ctrl** key and clicking each folder. When you click **Delete**, Explorer deletes all the selected folders.
- You cannot delete the Documents folder on the handheld.
- You cannot delete folders on the computer.

Capturing screens from a handheld

The Screen Capture tab lets you capture images of the screen from a connected TI-Nspire™ handheld. You can then resize the images, add or remove a border, copy them into documents, or save them as image files on your computer.

❶ Screen Capture tab

❷ Screen Capture toolbar

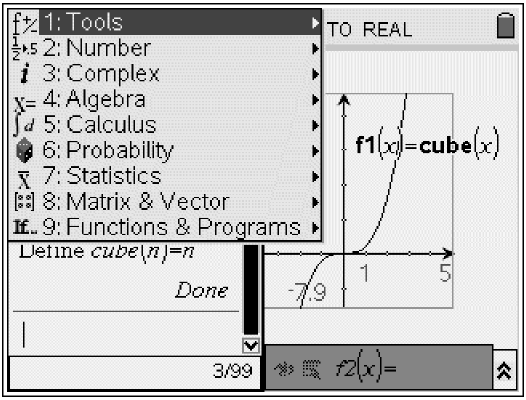
❸ Captured handheld screens (in thumbnail view)

A border is automatically added to each screen, but you can remove it. The size of a captured screen is 326 pixels wide by 246 pixels high, with or without a border.

Capturing a screen

1. Make sure the handheld is turned on and properly connected to your computer.
2. On the handheld, display the screen that you want to capture.
3. Click the **Screen Capture** tab in the TI-Nspire™ Computer Link Software window.
4. Click **File > Take screenshot** or click .

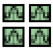
   The Screen Capture window shows the captured image.



Note: If you most recently removed the border from a screen, new screens appear without a border. If you most recently added a border to a screen, new screens appear with a border.

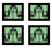
Viewing thumbnails of captured screens

You can view screens individually or as a group of images, called thumbnails. A reference name is displayed under each image. The thumbnail view also lets you select multiple screen images for copying, saving, and so on.

- To view screens as thumbnails, click **View > Thumbnails** or click .
- To view screens individually, click **View > Single Screen** or click .

Selecting multiple screens

Selecting multiple screens lets you quickly apply a modification to all of them. For example, you can select several screens and then resize them or remove their borders.

1. If necessary, click  to display the thumbnail view.
2. Use one of the following methods to select the screens.
   - Click **Edit > Select All** or press **Ctrl A** to select all the captured screens.
   - Click the first image that you want to select, and then hold down **Ctrl** on the computer keyboard as you click each additional image.
   - Select a range of images by clicking the first image in the range, holding down **Shift**, and clicking the last image in the range.

Resizing screens

You can save a larger or smaller version of a screen image by zooming in or out before you save it.

- To display a larger screen image, click **View > Zoom In** or click .
- To display a smaller screen image, click **View > Zoom Out** or click .

Adding or removing a border

The toolbar button for adding or removing a border toggles between add  and remove  depending on whether or not the selected image contains a border.

Note: If you most recently removed the border from a screen, new screens appear without a border. If you most recently added a border to a screen, new screens appear with a border.

1. Click the screen capture image to select it.
2. Click **Edit > Remove Border** or click  to remove the border.

   – or –

   Click **Edit > Add Border** or click  to add a border.

Adding or removing a border from a group of images

1. Click **View > Thumbnails** or click .
2. Select the group of images. You can either:
    - Click the first image you want to select, and then hold down **Ctrl** as you click each additional image.
    - Select a range of images by clicking the first image in the range, holding down **Shift**, and clicking the last image in the range.
3. Click **Edit > Remove Border** or click to remove the border.

   – or –

   Click **Edit > Add Border** or click to add a border.

Navigating among screen images

- ▶ To view the previous screen image, click **View > Previous Screen** or click .
- ▶ To view the next screen image, click **View > Next Screen** or click .

Saving captured screens as computer files

You can save captured screens on your computer in TIF, GIF, or JPEG formats. The screens are saved in your My Documents folder unless you specify a different location to save them. All screens are saved at the size they are currently displayed.

1. Select the captured screen or screens that you want to save.
2. Click **File > Save Screen** or click .
3. In the dialog box:
    a) Navigate to the folder in which you want to store the screen capture file.
    b) Select the file type for the appropriate image format.
    c) Type a file name. Use a name that describes the screen image.
    d) Click **Save**.

Note:

- If you have previously saved the selected screen image, clicking **File > Save Screen** or replaces the previous file. To save the file in a different location, with a different name, or as a different file format, you must click **File > Save Screen As**.
- To save all the images at once, click **File > Save All Screens**. When you do this, you select the location to save the files in the Save All window, but you do not specify file names. Each screen image is saved with its default file name. If that name already exists, you're prompted whether to replace the existing file.
- If you have unsaved screen images when you exit the TI-Nspire™ Computer Link Software, you are prompted to save them. If you choose to save the images, they are saved in your TI-Nspire/Screen Captures folder.

Copying a screen image to a computer application by dragging

1. Adjust the size of the TI-Nspire™ Computer Link Software window and the window of the other application so that you can see both windows on the computer screen.
2. In the TI-Nspire™ Computer Link Software window, click the captured screen to select it.
3. Drag the screen from TI-Nspire™ Computer Link Software and then drop it into the other application.

Copying a screen image by pasting

You can copy and paste a captured screen into an application that allows pasting images.

1. Click the captured screen to select it.
2. Press **Ctrl C** to copy the image to the Clipboard.
3. Click the other application at the point where you want to image to appear.
4. Press **Ctrl V** to paste the image into the application.

Backing up handheld documents on the computer

TI-Nspire™ Computer Link Software lets you save all of a handheld's documents as a single backup file on your computer. You can create as many backups as you like. You can later restore the documents to the handheld.

Creating a one-click backup

When you use the one-click backup feature, TI-Nspire™ Computer Link Software creates a backup file on the computer in your TI-Nspire/Backups folder. The file name includes the year, month, day, hour, minute, and seconds of the backup.

- Click **Tools > One Click Backup**.

  A progress message is displayed during the backup process.

Creating a backup in a specified folder

Use this method if you want to specify the folder and file to be used for a backup.

1. Click **Tools > Backup**.

   A dialog box is displayed to let you specify a backup file.
2. Browse to the folder where you want to create the backup file.
3. Type a name for the file, or click an existing backup file to replace it.
4. Click **Save**.

   A progress message is displayed during the backup process.

Restoring handheld documents from a backup

1. Click **Tools > Restore**.

   A dialog box is displayed to let you select a backup file.
2. Browse to the folder that contains the backup file.
3. Click the backup file.
4. Click **Restore**.

   A message is displayed to warn you that restoring replaces all documents on the handheld.
5. Click **OK** to proceed with the restoration.

   A progress message is displayed during the restoration.

If you cannot restore from a backup

In some cases, the device may not have enough memory for the restored files. TI-Nspire™ Computer Link Software detects this and gives you the option of expanding the backup file into individual documents on your computer. You can then selectively transfer documents to the device by using ordinary copy and move options.

Updating TI software

TI-Nspire™ Computer Link Software lets you update the operating system (OS) on your TI-Nspire™ handheld. You can update from the Web or from an OS file on your computer. You can also use the Help menu to visit the TI Education Web site.

Updating from the Web

1. On the handheld, close all open documents. The update process cannot begin unless all handheld documents are closed.
2. In TI-Nspire™ Computer Link Software, click **Tools > Check for Web Updates**.

   The software checks for a newer version of your handheld operating system. If a newer version is found, you are prompted to update or cancel.
3. If you want to choose a folder for storing a copy of the OS file, click **Browse**, and navigate to the folder.
4. Click **Update**, and then click to indicate that you accept the terms of the license agreement.

   The update begins. Progress messages are displayed during the update process.

Note: If the connection between the desktop and the handheld is interrupted before the update has completed, TI-Nspire™ Computer Link Software displays an error message.

Updating from a file on your computer

1. On the handheld, close all open documents. The update process cannot begin unless all handheld documents are closed.
2. In TI-Nspire™ Computer Link Software, click **Tools > Install OS**.
3. Browse to the computer folder containing the OS file, and double-click the file.

   TI-Nspire™ Computer Link Software requests confirmation that you want to update the OS.
4. Click **Yes**.

   The update begins. Progress messages are displayed during the update process.

Note: If the connection between the desktop and the handheld is interrupted before the update has completed, TI-Nspire™ Computer Link Software displays an error message.

Visiting the TI Education Web site

TI-Nspire™ Computer Link Software gives you an easy way to get current TI information on math and science, including product information, downloads, and a link to help you purchase TI educational products.

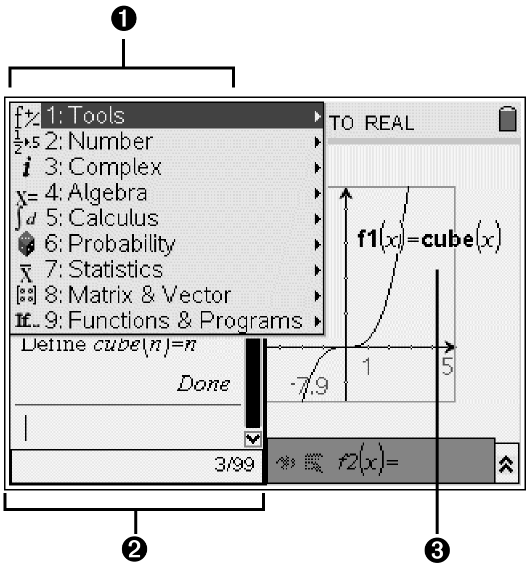
- Click **Help > TI Education Online**.

  The TI Education site is displayed in your Web browser.

Using Calculator

Getting started with the Calculator application

The Calculator application gives you a place to enter and evaluate math expressions. You can also use it to define variables, functions, and programs. When you define or edit a variable, function, or program, it becomes available to any TI-Nspire™ math and science learning technology application—such as Graphs & Geometry—that resides in the same problem.



❶ Calculator menu – This menu is available anytime you are in the Calculator work area. Press menu to display the menu. The menu in this screen snapshot may not exactly match the menu on your screen.

❷ Calculator work area

- You enter a math expression on the entry line and then press enter to evaluate the expression.
- Expressions display 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 TI-Nspire™ application

The Calculator tool menu

The Calculator tool menu lets you to enter and evaluate a variety of math expressions.

Menu Name	Menu Option	Function
Tools		
	Define	Inserts the **Define** command.
	Recall Definition	Lets you view, reuse, or modify a function or program that you have defined.
	Delete Variable	Inserts the **delVar** command.
	Clear a-z	Deletes all variables with single-letter names.
	Clear History	Deletes all expressions in the Calculator history.
	Insert Comment	Lets you insert text.
Number		
	Convert to Decimal	Inserts ▸**Decimal** command.
	Factor	Inserts **factor()**.
	Least Common Multiple	Inserts **lcm()**.
	Greatest Common Divisor	Inserts **gcd()** function.
	Remainder	Inserts **remain()**.
	Fraction Tools	Lets you select **propFrac()**, **getNum()**, **getDenom()**.
	Number Tools	Lets you select **round()**, **iPart()**, **fPart()**, **sign()**, **mod()**, **floor()**, or **ceiling()**.
Complex		
	Complex Conjugate	Inserts **conj()**.
	Real Part	Inserts **real()**.
	Imaginary Part	Inserts **imag()**.

Menu Name	Menu Option	Function
	Polar Angle	Inserts **angle()**.
	Magnitude	Inserts the absolute value template.
	Convert to Polar	Inserts ▶**Polar** command.
	Convert to Rectangular	Inserts ▶**Rect** command.
Calculations		
	Numerical Solve	Inserts **nSolve()**.
	Numerical Function Minimum	Inserts **nfMin()**.
	Numerical Function Maximum	Inserts **nfMax()**.
	Numerical Derivative	Inserts **nDeriv()**.
	Numerical Integral	Inserts **nInt()**.
	Finance Solver	Starts the Finance Solver.
Probability		
	Factorial (!)	Inserts **!**.
	Permutations	Inserts **nPr()**.
	Combinations	Inserts **nCr()**.
	Random	Lets you select **rand()**, **randInt()**, **randBin()**, **randNorm()**, **randSamp()**, or **RandSeed**.
	Distributions	Lets you select from several distributions, such as **Normal Pdf**, **Binomial Cdf**, and **Inverse** F.
Statistics		

Menu Name	Menu Option	Function
	Stat Calculations	Lets you select from several statistics calculations, such as one-variable analysis, two-variable analysis, and regressions.
	Stat Results	Inserts the *stat.results* variable.
	List Math	Lets you select from several list calculations, such as minimum, maximum, and mean.
	List Operations	Lets you select from several list operations, such as sorting, filling, and converting to a matrix.
	Distributions	Lets you select from several distributions, such as **Normal Pdf**, **Binomial Cdf**, and **Inverse** F.
	Confidence Intervals	Lets you select from several confidence intervals, such as **t interval** and **z interval**.
	Stat Tests	Lets you select from several tests such as **ANOVA**, **t test**, **z test**.
Matrix & Vector		
	Transpose	Inserts ^{T}
	Determinant	Inserts **det()**.
	Row-Echelon Form	Inserts **ref()**.
	Reduced Row-Echelon Form	Inserts **rref()**.
	Simultaneous	Inserts **simult()**.
	Create	Lets you select from several matrix-creation options, such as identity, diagonal, submatrix, and others.

Menu Name	Menu Option	Function
	Norms	Lets you select **norm()**, **rowNorm()**, or **colNorm()**.
	Dimensions	Lets you select **dim()**, **rowDim()**, or **colDim()**.
	Row Operations	Lets you select **rowSwap()**, **rowAdd()**, **mRow()**, or **mRowAdd()**.
	Element Operations	Inserts “dot” operators such as **.+** (dot add) and **.^** (dot power).
	Advanced	Inserts **eigVl()**, **eigVc()**, **LU**, or **QR**.
	Vector	Inserts **unitV()**, **crossP()**, **dotP()**, **▶Polar**, **▶Rect** ,**▶Cylind**, or **▶Sphere**.
 **Functions & Programs**		
	Func...EndFunc	Inserts a template for creating a function.
	Prgm...EndPrgm	Inserts a template for creating a program.
	Local	Inserts the **Local** command.
	Control	Lets you select from a list of function and program-control templates, such as **If...Then...EndIf**, **While...EndWhile**, **Try...Else...EndTry**, and others.
	Transfer	Inserts transfer commands **Return**, **Cycle**, **Exit**, **Lbl**, **Stop**, or **Goto**.

Menu Name	Menu Option	Function
	Disp	Displays intermediate results.
	Mode	Inserts commands for setting or reading modes, such as display digits, angle mode, base mode, and others.
	Add New Line	Starts a new line within a function or program definition.

Before you begin

- Turn on the handheld, and add a Calculator application to a document.

Entering and evaluating math expressions

Options for entering expressions

Calculator lets you enter and edit expressions through several methods.

- By pressing keys on the handheld keypad
- By selecting items from the Calculator menu
- By selecting items from the Catalog ( )

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.

2^8

3. Press ▶ to return the cursor to the baseline, and then type `43` `12`.

$2^8 \cdot 43/12$

4. Press enter to evaluate the expression.

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

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

Note: If a result does not fit on the same line with the expression, it displays 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 displays in a fractional form. 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 ctrl enter instead of enter to evaluate the expression.

$$\frac{2^8 \cdot 43}{12} \qquad 917.333$$

Pressing ctrl enter forces approximate result.

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

$$\frac{2^8 \cdot 43.}{12} \qquad 917.333$$

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

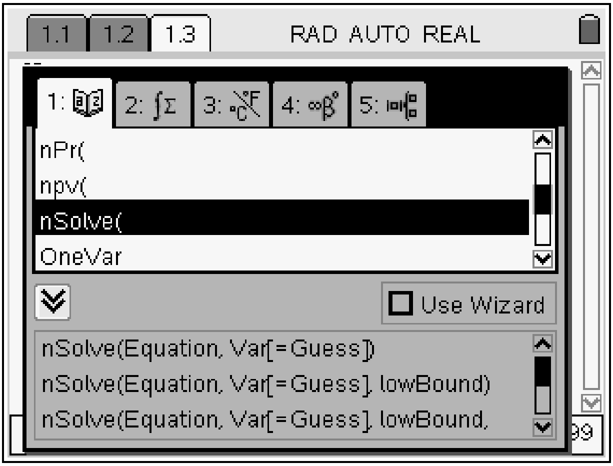
$$\mathrm{approx}\left(\frac{2^8 \cdot 43}{12}\right) \qquad 917.333$$

- By changing the document’s **Auto or Approximate** mode setting to Approximate. (Press ctrl ▶ to display the **File** menu, and then select **Document Settings**.) 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. Press to open the Catalog.



Note: Some functions have a wizard that prompts you for each argument. If you prefer to enter the argument values directly on the entry line, you may need to disable the wizard.

2. Press the number key for the category of the item. For example, press 1 to show the alphabetic list.

 shows an alphabetic list of functions and commands.

 shows math functions and commands by category.

 shows a table of symbols.

 shows expression templates.

3. Press ▼ and then use ◀, ▶, ▲, or ▼ as necessary to select the item that you want to insert.

   Note: To see syntax examples of the selected item, press tab, and then press enter to alternately show or hide the Help. To move back to the selected item, press CAPS tab.

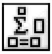
4. Press enter to insert the item into the entry line.

Using an expression template

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

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

1. Press ctrl 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.

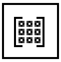
3. Use the arrow keys to move the cursor to each element's position, and type a value or expression for each element.

4. Press enter to evaluate the expression.

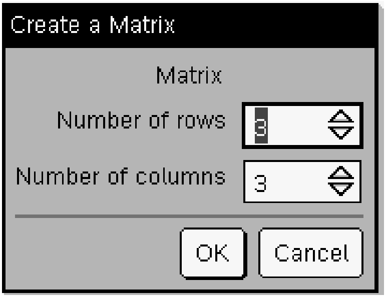
$$\sum_{n=3}^{7}(n) \qquad 25$$

Creating matrices

1. Press ctrl $\frac{\square}{\square}$ to open the Template palette.

2. Select .

   The Create a Matrix dialog box displays.



3. Type the **Number of rows**.
4. Type the **Number of columns**, and then select **OK**.

   Calculator displays 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 press enter to define the matrix.

Inserting a row or column into a matrix

- To insert a new row, press ↵.
- To insert a new column, hold down CAPS ⇧ and press enter.

Inserting expressions using a wizard

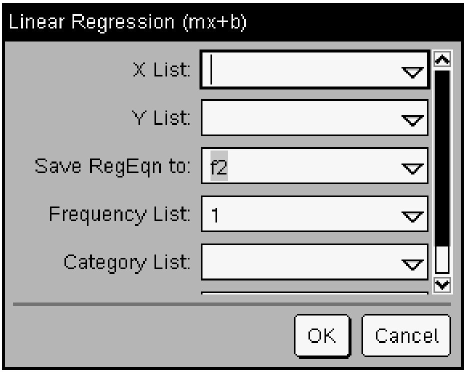
You can use a wizard to simplify entering some expressions. The wizard contains labeled boxes to help you enter the arguments in the expression.

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. Press to open the Catalog.
2. Press **1** to show the alphabetic list of functions.
3. Press ▼, and then press **L** to jump to the entries that begin with "L."
4. Press ▼ as necessary to highlight **LinRegMx**.
5. If the Use Wizard option is not checked:
    a) Press tab tab to highlight the Use Wizard button.
    b) Press enter to change the setting.
    c) Press tab tab to highlight **LinRegMx** again.
6. Press enter.

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



7. Type `{1,2,3,4,5}` as **X List**.
8. Press tab to move to the **Y List** box.
9. Type `{5,8,11,14,17}` as **Y List**.
10. 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.
11. Select **OK** to close the wizard and insert the expression into the entry line.

Calculator inserts the expression and adds a statement to display the variable *stat.results*, which will contain the results.

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

Calculator then displays the *stat.results* variables.

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

$$\begin{bmatrix} \text{"Title"} & \text{"Linear Regression (mx+b)"} \\ \text{"RegEqn"} & \text{"m*x+b"} \\ \text{"m"} & 3. \\ \text{"b"} & 2. \\ \text{"r}^2\text{"} & 1. \\ \text{"r"} & 1. \\ \text{"Resid"} & \text{"\{...\}"} \end{bmatrix}$$

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

Creating a piecewise function

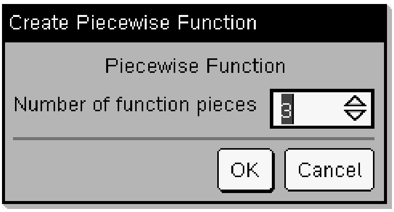
1. Begin the function definition. For example, type the following.

   `Define f(x,y)=`

2. Press to open the Template palette.

3. Select .

   The Piecewise Function dialog box displays.



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

   Calculator displays a template with spaces for the pieces.

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

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

Deferring evaluation

You don't have to complete and evaluate an expression as soon as you begin typing it. You can type part of an expression, leave to check some work you did on another page, and then come back to complete the expression later.

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™ math and science learning technology 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.

Exception: Variables created with the **Local** command within a user-defined function or program are not accessible outside that function or program.

Storing a value in a variable

This example creates a variable named *num* and stores the result of the expression $5+8^3$ in that variable.

1. On the Calculator entry line, type the expression `5+8^3`.

$$5+8^3$$

2. Press ► to expand the cursor to the baseline.

$$5+8^3$$

3. Press ctrl sto► var and then type the variable name `num`.

$$5+8^3 \rightarrow num$$

   This means: Calculate $5+8^3$ and store the result as a variable named *num*.

4. Press enter.

   Calculator creates the variable *num* and stores the result there.

$$5+8^3 \rightarrow num \qquad 517$$

Alternative methods for storing a variable

As alternatives to using → (store), you can use "`:=`" or the **Define** command. All of the following statements are equivalent.

$5+8^3 \rightarrow num$

$num := 5+8^3$

Define $num=5+8^3$

Checking a variable's value

You can check the value of an existing variable by entering its name on the Calculator entry line.

▶ On the Calculator entry line, type the variable name **`num`** and press enter.

   The value most recently stored in *num* displays as the result.

num	517

Using a variable in a calculation

After storing a value in a variable, you can use the variable name in an expression as a substitute for the stored value.

1. Type `4` × `25` × `num^2` on the entry line, and press enter.

   Calculator substitutes 517, the value currently assigned to *num*, and evaluates the expression.

$$4\cdot 25\cdot num^2 \qquad 26728900$$

2. Type `4` × `25` × `nonum^2` on the entry line, and press enter.

$$4\cdot 25\cdot nonum^2$$

"Error: Variable is not defined"

Because the variable *nonum* has not been defined, the expression returns an error message.

Updating a variable

If you want to update a variable with the result of a calculation, you must store the result explicitly.

Entry	Result	Comment
`a := 2`	2	
a^3	8	Result not stored in variable *a*.
`a`	2	
$a := a^3$	8	Variable *a* updated with result.
`a`	8	
$a^2 \rightarrow a$	64	Variable *a* updated with result.
`a`	64	

Types of variables

You can store the following TI-Nspire™ math and science learning technology data types as variables:

Data type	Examples
Expression	2.54 1.25E6 2π 2+3i $\sqrt{2}/2$
List	{2, 4, 6, 8} {1, 1, 2}
Matrix	$\begin{bmatrix} 1 & 2 & 3 \\ 3 & 6 & 9 \end{bmatrix}$ This can be entered as: `[1,2,3;3,6,9]`
Character string	"Hello" "xmin/10" "The answer is:"
Function	myfunc(arg) ellipse(x, y, r1, r2)

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.

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

Rules for naming variables

Note: In the unlikely event that you create a variable with the same name as one used for statistical analysis or by the Finance Solver, an error condition could occur.

- Variable names must be in one of the forms *xxx* or *xxx.yyy*. The *xxx* part can have 1 to 16 characters. The *yyy* part, if used, can have 1 to 15 characters. If you use the *xxx.yyy* form, both *xxx* and *yyy* are required; you cannot start or end a variable name with a period ".”
- Characters can consist of letters, digits, and the underscore character (_). Letters can be U.S. or Greek letters (but not Π or π), accented letters, and international letters.
- You can use uppercase or lowercase letters. The names *AB22*, *Ab22*, *aB22*, and *ab22* all refer to the same variable.
- You cannot use a digit as the first character of *xxx* or *yyy*.
- Do not use spaces.
- If you want a variable to be treated as a complex number, use an underscore as the last character of the name.
- You cannot use an underscore as the first character of the name.
- You cannot use a preassigned variable, function, or command name, such as Ans, **min**, or **tan**.

  Note: For a complete list of TI-Nspire™ functions, refer to the Reference Guide.

Here are some examples:

Variable names	Valid?
Myvar, my.var	Yes
My var, list 1	No. Contains a space.
a, b, c	Yes
Log, Ans	No. Preassigned to a system function or variable.
Log1, list1.a, list1.b	Yes
3rdTotal, list1.1	No. *xxx* or *yyy* starts with a digit.

Reusing the last answer

Each instance of Calculator automatically stores the last calculated result as a variable named Ans. You can use Ans to create a chain of calculations.

Note: Do not link to Ans or any system variable. Doing so 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*).

As an example of using Ans, calculate the area of a garden plot that is 1.7 meters by 4.2 meters. Then use the area to calculate the yield per square meter if the plot produces a total of 147 tomatoes.

1. On the Calculator entry line, type `1.7` [×] `4.2`, and press [enter].

$1.7 \cdot 4.2$	7.14

2. Type `147` [÷] `ans`, and press [enter] to find the yield.

$\frac{147}{7.14}$	20.5882

As a second example, calculate $\frac{3.76}{-7.9+\sqrt{5}}$ and then add `2*log(45)`.

3. Type `3.76` [÷] `(`[(–)]`7.9+sqrt(5))`, and press [enter].

$\frac{3.76}{^-7.9+\sqrt{5}}$	$^-.66385$

4. Type `ans+2` [×] `log(45)`, and press [enter].

$^-.66384977522033+2\cdot\log_{10}(45)$	2.64258

Temporarily substituting a value for a variable

Use the "|" (such that) operator to assign a value to a variable for just a single execution of the expression.

a:=200.12	200.12
a^2 | a=100	10000
a	200.12

Creating user-defined functions and programs

You can use the **Define** command to create your own functions and programs. You must create them in the Calculator application, but you can use them in other TI-Nspire™ applications.

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.

Define $cube(x)=x^3$	*Done*

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

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

$cube(2)$	8

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.

   define $g(x,y)=$

2. Press menu to display the Calculator menu.
3. On the **Functions & Programs** menu, select **Func...EndFunc**.

   Calculator inserts the template.

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

4. Press menu to display the Calculator menu.
5. On 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
```

6. 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
```

7. Press enter to complete the definition.
8. Evaluate `g(3,-7)` to test the function.

g(3,-7)	3

Defining a multiple-line function manually

Note: To start each new line without completing the function definition, you press ↵ instead of pressing enter.

As an example, define a function **cum_sum(*x*)** that calculates the cumulative sum of integers from 1 through *x*. You can type the underscore symbol by pressing ctrl ⎵.

1. On the Calculator entry line, type `Define cum_sum(x)=`. Do not press [enter] yet.

   $$\text{define } cum\_sum(x)=$$

2. Press [menu] to display the Calculator menu.
3. On the **Functions & Programs** menu, select **Func...EndFunc**.

   Calculator inserts the template.

   ```
   define cum_sum(x)=Func
                     [ ]
                     EndFunc
   ```

4. Type the following lines, pressing [↵] at the end of each line.

   ```
   Define cum_sum(x)=Func
                      Local i,temp_sum
                      temp_sum:=0
                      For i,1,x
                      temp_sum:=temp_sum+i
                      EndFor
                      Return temp_sum
                      EndFunc
   ```

5. After typing `Return temp_sum`, press [enter] to complete the definition.
6. Evaluate `cum_sum(5)` to test the function.

$cum\_sum(5)$	15

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 display the text "x greater than y" or "x not greater than 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.

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

2. Press menu to display the Calculator menu.
3. On the **Functions & Programs** menu, select **Prgm...EndPrgm**.

   Calculator inserts the template.

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

4. Press menu to display the Calculator menu.
5. On the **Functions & Programs** menu, select **Control**, and then select **If...Then...Else...EndIf**.

   Calculator inserts the template.

```
Define prog1(x,y)=Prgm
                  If  Then
                  []
                  Else
                  []
                  EndIf
                  EndPrgm
```

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

Define *prog1*(*x*,*y*)=Prgm
If *x*>*y* Then
Disp *x*," greater than ",*y*
Else
Disp *x*," not greater than ",*y*
EndIf
EndPrgm

Done

7. Press (enter) to complete the definition.
8. Execute `prog1(3,-7)` to test the program.

prog1(3,⁻7)

3 greater than ⁻7

Done

Recalling a function or program definition

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

1. Press (menu) to display the Calculator menu.
2. On the **Tools** menu, select **Recall Definition**.

   A dialog box appears with a list of defined functions and programs.
3. 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) to cycle through the parameters of a template.

  – or –

Press ◄, ►, ▲, 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. Press ◄, ►, ▲, or ▼ to move the cursor to a starting point.
2. Press and hold [CAPS ⇧] and 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 [clear ←].

Financial calculations

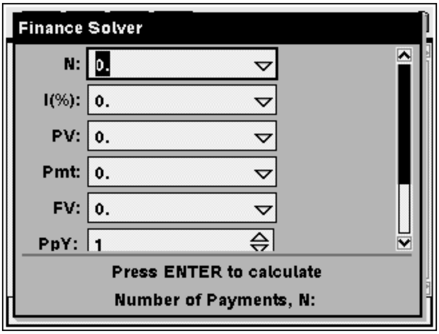
Several TI-Nspire™ functions provide financial calculations, such as time value of money, amortization calculations, and return on investment calculations.

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

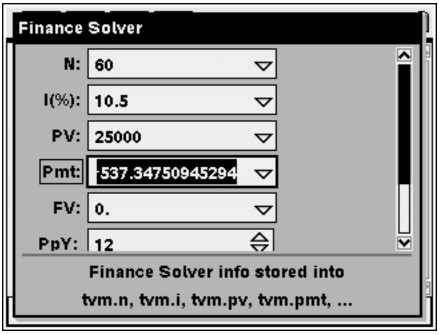
1. Press [menu] to display the Calculator menu.
2. On the **Calculations** menu, select **Finance Solver**.

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



3. Enter each known value, using the **tab** key (tab) to cycle through the items.
   - The help information at the bottom of the 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).
4. Press (tab) as necessary to select the item that you want to calculate, and then press (enter).

   The 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, refer to the Reference Guide.

Working with the Calculator history

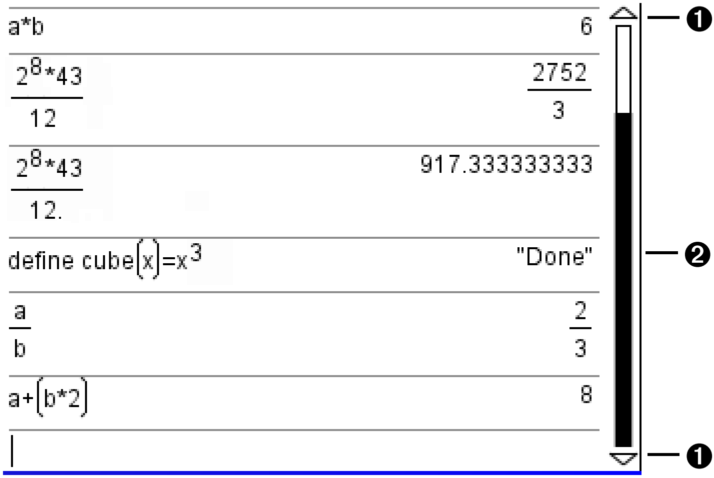
As you enter and evaluate expressions in the Calculator application, each entry/result pair is saved in the Calculator history. The history gives you a way to review your calculations, repeat a set of calculations, and copy expressions for reuse in other pages or documents.

Viewing the Calculator history

The history of the expressions you have entered accumulates above the entry line, with the most recent expression at the bottom. If the history does not fit in the Calculator work area, you can scroll through the history.

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

▶ Press ▲ or ▼.



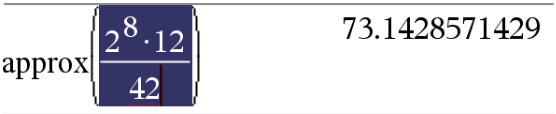
❶ Scrollbar buttons

❷ Scroll position indicator

Reusing a previous expression or result

You can copy an expression, subexpression, or result from the Calculator history and paste it into the entry line or into other TI-Nspire™ applications.

1. Scroll to the item that you want to copy.
2. Select the item.



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.

3. Press ctrl C to make the copy.
4. Select the location where you want the copy.
5. Press ctrl V to paste the copy.

$$\sqrt{\frac{2^{8}\cdot 12}{42}} \qquad 8.55236$$

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. Use the arrow keys to select the expression that you want to delete.

$$\sqrt{\frac{2^{8}\cdot 12}{42}} \qquad 8.55236$$

2. Press clear.

   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.

1. Press menu to display the Calculator menu.
2. On the **Tools** menu, select **Clear History**.

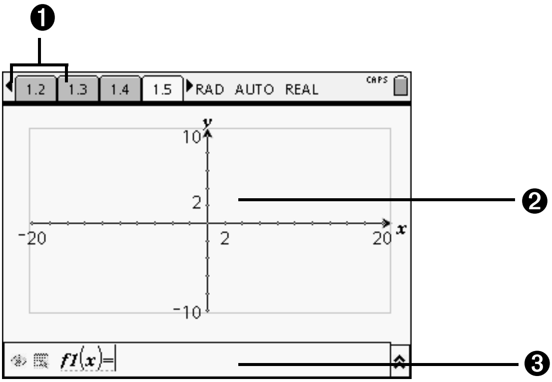
   All expressions and results are removed from the history.

Using Graphs & Geometry

Getting started with Graphs & Geometry

The Graphs & Geometry application enables you to:

- Graph and explore functions.
- Create and explore geometric shapes.
- Animate points on objects or graphs and explore their behavior.
- Graph data collected by the Data Collection tool.
- Explore graphical and geometric transformations.
- Explore and investigate concepts of calculus.
- Link to data created by other applications and utilize it in Graphs & Geometry.



❶ Problem/Page number counter

❷ Sample Graphs & Geometry work area in Graphing View

❸ Graphs & Geometry data entry line

Getting acquainted with Graphs & Geometry

► Turn on the TI-Nspire™ handheld, and add the Graphs & Geometry application to your page.

When you add Graphs & Geometry to a page, your work area contains the *x* and *y* axes for a graph, as well as a function entry line and Graphs & Geometry-specific tools.

The basic components of the Graphs & Geometry application are the:

- Tool menu line

- Work area (which contains the axes)
- Entry line.

The Tool menu

Press (menu) to open the Tools menu. These menus and tools enable you to graph and explore different types of functions, draw and explore geometric structures, as well as other capabilities which will be covered in this chapter.

The following tables contain a brief summary of what each menu contains or tool enables you to do within the Graphs & Geometry work area.

Note: The number that precedes each title is the numeric entry for accessing the tool using the handheld keys or the virtual keypad on the computer. For example, to draw a circle, you would press (menu) (8) (1).

Menu Option List	Overview of Tool Actions
1: Tools	Provides tools to access the pointer, hide or show various graph features, add text, delete all objects in the work area, access the calculate tool, and access the attributes for an object or function.
2: View	Provides tools to manipulate the work area features and display.
3: Graph Type	Enables you to select the type of graph to plot: function, parametric, or scatter plot.
4: Window	Provides different Zoom settings as well as the ability to define *x*-max, *x*-min, *y*-max, and *y*-min.
5: Trace	Places and activates a trace tool on the graph, or enables you to remove geometric trace.
6: Points & Lines	Provides tools for drawing various types of points, lines, segments, rays, and vectors.
7: Measurement	Provides tools for measuring angles, lengths, areas, and slope.
8: Shapes	Provides tools for drawing circles, triangles, rectangles, and polygons.

Menu Option List	Overview of Tool Actions
9: Construction	Provides tools to define perpendicular and parallel lines, bisectors, midpoints, locus, compass, and perform measurement transfers.
A: Transformation	Provides tools for symmetry, reflection, translation, rotation, and dilation.

Tools Menu Tools

Tool name	Tool function
1: Pointer	Selects, moves, and manipulates objects.
2: Hide/Show	Enables you to hide or display any object, function, or feature on the work area.
3: Attributes	Enables you to change the attributes of a selected object in the work area. Attributes vary depending upon the object selected. When this tool is selected, select the object or function whose attributes you want to change.
4: Delete All	Removes all objects and graphed functions from the page.
5: Text	Places user-created alpha-numeric values on the page. Numerical values can be applied to objects. The tool can be used to enter a function and graph it.
6: Coordinates and Equations	Displays the coordinates of a point or the equation of a line or circle.
7: Calculate	Opens the calculate tool to perform calculations using measurements, numerical values, or calculation results. This tool is different from the Calculator application.
8: Redefine	Redefines a previously defined point to a new location. For example, it can define a point in free space to a location on an object or from one object to another object.

Tool name	Tool function
9: Data Collection	Adds the Data Collection tool to the current Graphs & Geometry page. See the Data Collection chapter for details on using this tool.

View Menu Tools

Tool name	Tool function
1: Graphing	Places the work area in graphing mode. Axes fill the work area, and the entry lines displays at the bottom of the screen. This is the default display when Graphs & Geometry is added to a page.
2: Plane Geometry	Places the work area in geometry mode. Show scale displays, but no axes, grid, or entry line displays.
3: Show Analytic Window	Opens a small graphing window on a plane geometry work area. Places the Graphs & Geometry work area in modeling mode. This tool can be used only after Plane Geometry is selected.
4: Hide (Show) Axes	Hides the axes if they are currently displayed on the page. Displays the axes if none are displayed on the page. Cartesian axes are the supported axes.
5: Show (Hide) Grid	Turns the grid on or off on the page. Objects can be attached to the grid when the grid is displayed.
6: Hide (Show) Entry Line	Hides or displays the entry line on the page.
7: Show (Hide) Scale	Toggles between showing and hiding the scale legend on the work area. When the scale is shown, the value and/or units can be changed to desired values/units. This applies only to geometric constructions.

Tool name	Tool function
8: Add Function Table	Launches the Lists & Spreadsheet function table. When launched from Graphs & Geometry, it is pre-populated with all functions defined in the problem with the exception of hidden functions. More information on using Function Tables is available in the Lists & Spreadsheet chapter of this document.

Graphing Type Menu Tools

Tool name	Tool function
1: Function	Displays the function mode entry line at the bottom of the work area.
2: Parametric	Displays the parametric mode entry line at the bottom of the work area. This display shows the t-min, t-max and t-step values. The defaults are 0-2π for t-min, t-max, and π/24 for t-step.
3: Scatter Plot	Displays the Scatter Plot mode entry line at the bottom of the work area.

Window Menu Tools

Tool name	Tool function
1: Window Settings	Displays a Window Parameters dialog that enables you to enter the *x*-min, *x*-max, *y*-min, and *y*-max values for the axes.
2: Zoom - Box	Enables you to define an area that you want to enlarge.
3: Zoom - In	Enables you to define the center point of the zoom in location. The Zoom In factor is approximately 2.
4: Zoom - Out	Enables you to define the center point of the zoom out location. The Zoom Out factor is approximately 2.

Tool name	Tool function
5: Zoom - Standard	Automatically sets *x*-min, *x*-max, *y*-min, and *y*-max to center the origin. The *x* and *y* scale factors are equal. This is the default axes setting when Graphs & Geometry is first added to a page.
6: Zoom - Quadrant 1	Automatically sets *x*-min, *x*-max, *y*-min, and *y*-max to emphasize the first quadrant. The *x* and *y* scale factors are equal.
7: Zoom - User	If you have modified any window settings (such as x-min), Zoom-User saves the present settings. If you have not modified any window settings since last selecting Zoom-User, Zoom-User restores those settings.
8: Zoom - Trig	Automatically sets *x*-min and *x*-max to integer multiples of π. The *x* and *y* scale factors are equal.
9: Zoom - Data	Redefines the axes so that all statistical data points are displayed.
A: Zoom - Fit	Recalculates *y*-min and *y*-max to include the minimum and maximum *y* values of all functions between the current *x*-min and *x*-max. Hidden functions are not included.

Trace Menu Tools

Tool name	Tool function
1: Graph Trace	Places and activates a trace point on the graph that allows you to trace a function. Trace identifies points of interest as they are encountered during the trace.
2: Geometry Trace	Enables you to view the pathway of a geometric or analytic object (such as a function graph) on the work area. The pathway has a delayed fade. As more movement occurs on the work area, older portions of the pathway fade. If you temporarily halt movement, a portion of the trace path remains displayed.

Tool name	Tool function
3: Erase Geometry Trace	Halts geometric trace and erases all persistent pathways on the work area.

Points and Lines Menu Tools

Tool name	Tool function
1: Point	Constructs a point defined in free space, on an object, or at the intersection of two objects.
2: Point On	Constructs a point defined on an object. When the object is a function graph, the coordinates are displayed.
3: Intersection Point	Constructs a point at each intersection of two selected objects.
4: Line	Constructs an infinite line defined by two points or by a point and a direction. If you press CAPS while creating the line, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.
5: Segment	Constructs a segment, defined by two end points, which may be created or defined in free space or on a defined object. If you press CAPS while creating the segment, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.
6: Ray	Constructs a ray, defined by defined by two points or by a point and a direction, extending infinitely. If you press CAPS while creating the ray, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.
7: Tangent	Creates a tangent line.

Tool name	Tool function
8: Vector	Constructs a vector with magnitude and direction defined by two points. If you press [CAPS] while creating the vector, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.

Measurement Menu Tools

Tool name	Tool function
1: Length	Displays the distance between two selected points or the length of a segment, perimeter, circumference, or radius.
2: Area	Displays the area of a selected polygon or circle.
3: Slope	Displays the slope of a selected line or segment. A vertical slope is represented by ∞.
4: Angle	Displays the measure of an angle or an angle defined by three selected points.
5: Integral	Calculates and displays the numerical value of the integral of a selected function, and shades the area between the curve and the x-axis from point a to point b.

Shapes Menu Tools

Tool name	Tool function
1: Circle	Constructs a circle. The center point is defined by the first click on the page and the radius is determined by the second click.
2: Triangle	Constructs a triangle, defined by three points (vertices), which may be created or defined in free space or on a defined object.
3: Rectangle	Constructs a rectangle.

Tool name	Tool function
4: Polygon	Constructs an *n*-sided polygon. Each click defines a vertex, and the polygon is completed by clicking the initial vertex or by pressing enter.
5: Regular Polygon	Constructs an *n*-sided regular polygon.

Construction Menu Tools

Tool name	Tool function
1: Perpendicular	Constructs a line perpendicular to a selected line, segment, ray, vector, axis, or side of a polygon, and passing through a created or selected point.
2: Parallel	Constructs a line parallel to a selected line, segment, ray, vector, axis, or side of a polygon, and passing through a created or selected point.
3: Perpendicular Bisector	Constructs a perpendicular line that bisects two points, a segment, or side of a polygon.
4: Angle Bisector	Constructs a line that bisects an angle identified by three selected points where the second point is the vertex.
5: Midpoint	Constructs a midpoint of two selected points, a segment, or side of a polygon.
6: Locus	Constructs the locus of a point or object defined by the movement of a driver point along a pathway. Pathways are geometric shapes and function graphs.
7: Compass	Constructs a circle from a center point with a radius defined by a selected segment or the distance between two points.
8: Measurement Transfer	Transfers an entered or measured value to a selected object, axis, or function graph. If the original value changes, the change is also reflected in the transferred measurement.

Transformation Menu Tools

Tool name	Tool function
1: Symmetry	Creates the image of an object rotated 180° around a point.
2: Reflection	Creates the image of an object reflected across a line, segment, ray, vector, axis, or side of a polygon.
3: Translation	Creates the image of an object translated by a specified vector.
4: Rotation	Creates the image of an object rotated around a point by a specified angular value.
5: Dilation	Creates the image of an object dilated from a point by a specified factor.

Note: When you select a tool to use, that tool's icon displays in the upper left corner of the Graphs & Geometry page. It is there to remind you what tool is currently active.

Using the Context menu

The context menu provides the tools most commonly used with the selected object, function, or axes.

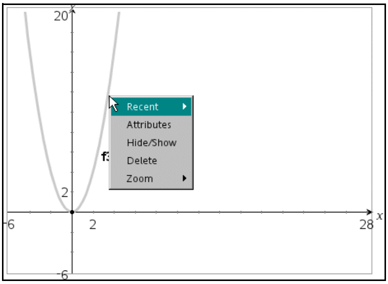
To display the context menu, press ctrl menu on an object, function, or anywhere on the work area.

The first two options on this menu are:

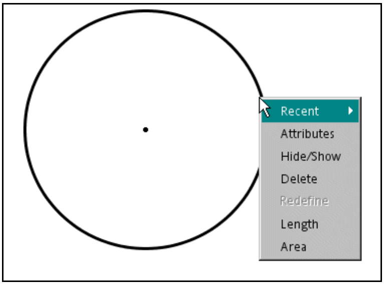
- Recent ▸: lists the 9 most recent tools you used. This is a session-level listing. The tools used on any Graphs & Geometry page are shown, regardless of the document in which they are used.
- Attributes: enables you to access the attributes appropriate for the function, object, or work area

Additional options display on the menu appropriate for your selection. For example, the Context menu for a triangle also contains the Hide/Show, Delete, Length, and Area options.

The following examples show the context menu for a function and a circle.



Context menu for a function (analytic object)



Context menu for a geometric object

The work area

There are two work area views available:

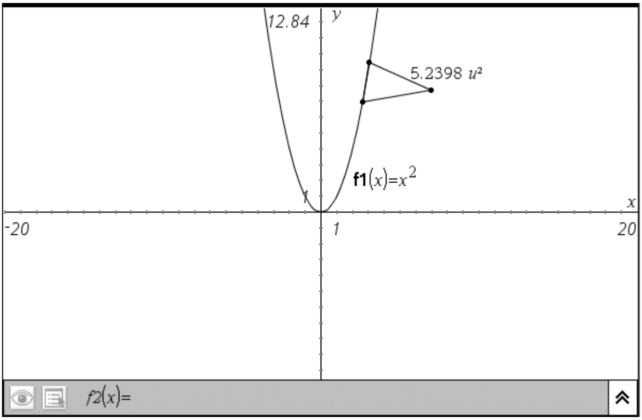
- Graphing
- Plane Geometry

The graphing view

The graphing view is the default Graphs & Geometry work area display. It contains

- coordinate axes in the Zoom Standard format (1:1 scale)
- the entry line from which you can graph up to 100 functions.

Axes, entry line, and grid can all be displayed or hidden, but in this view, no scale for any drawn shapes (e.g. Circle, etc.) can be displayed. All objects created in this view are analytic objects. Therefore, their displayed size and proportion are affected only by the scale of the axis system (the command "Show Scale" has no effect).



The plane geometry view

The plane geometry view removes the axes and entry line from the work area to enable you to draw geometric shapes and explore them. In this view, you can display and set a scale for your drawings.

To change to Plane Geometry view:

1. From the View menu, select the Plane Geometry View tool.

   Press menu 2 2.

2. The display refreshes to clear the axes and entry line and display a default scale. Any graphs or drawings created in graphing view are not displayed on the plane geometry area.

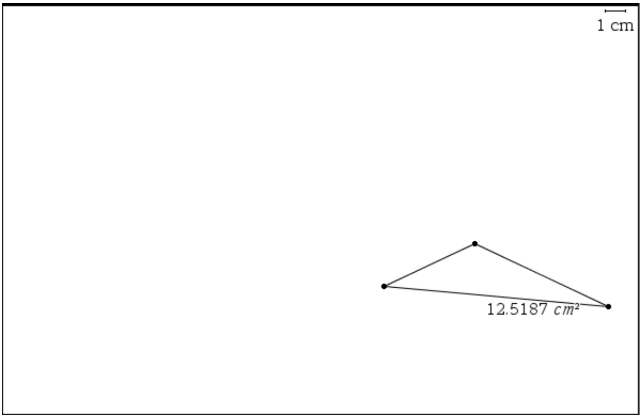
To return to graphing mode:

► From the View Menu, select the Graphing View tool.

  Press menu 2 1.

  The display refreshes to show the axes and entry line.

  Note: Any geometric constructions created while in the plane geometry view are retained and displayed along with any previously-created graphs.



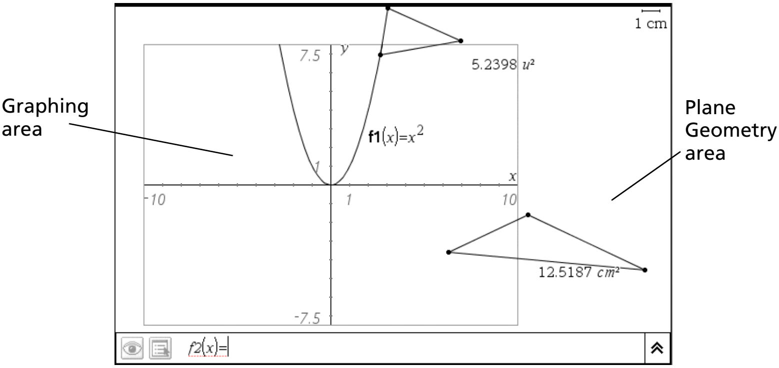
The analytic window

The analytic (graphing) window is available in the plane geometry view. It adds an analytic (graphing) window on top of a portion of the plane geometry work area. This provides a combination work area that enables you to use both work area types without toggling the view between them.

To open the analytic window:

1. Ensure that the work area is in Plane Geometry view.
2. From the View menu, select Show Analytic Window .

   Press menu 2 3.
3. A reduced size graphing window opens on the lower left corner of the plane geometry space.



Modeling view - shows the previous two views and the work done on both.

You can alter the work area, without changing the view, to temporarily:

- hide the axes. Any graphs or objects remain displayed on the work area.
- hide the entry line.
- hide the scale.
- resize the axes using the zoom tools or by dragging tic marks.

To display more of the plane geometry area, pan the screen.

To remove the analytic window from the work area

1. From the View menu, select Hide Analytic Window.

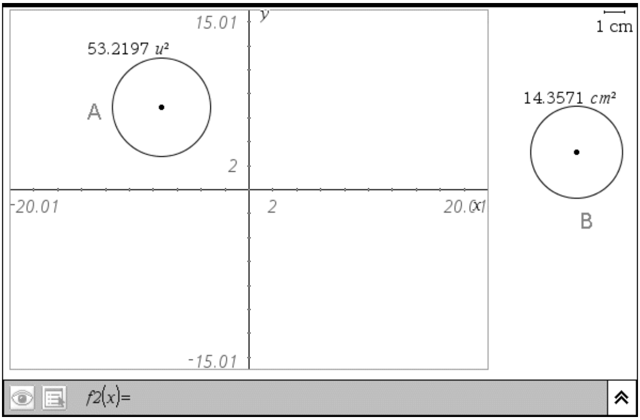
   Press menu 2 3.

Object behavior in different views

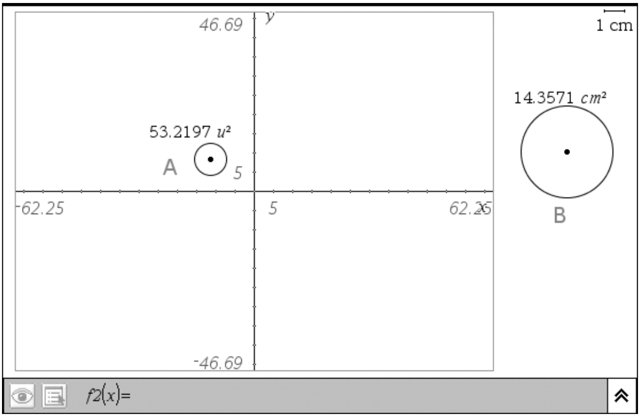
When you create an object in the graph area, it is called an analytic object, and all points of the object reside on the graph plane. When you change the axes scale, you automatically affect the appearance of the object. If you calculate a value associated with the object such as the area, only generic units are assigned (u for unit). These objects remain associated with the coordinate plane until you delete them or redefine them to the plane geometry area. When working with a modeling view work area, you cannot move an analytic object onto the plane geometry area.

When you create an object in the plane geometry area, it is a geometric object. These objects can have an assigned scale, such as miles or centimeters, instead of u for units. You can lock a point, such as one vertex of a triangle, on the work area, but since the object is not tied to a coordinate plane, you cannot display coordinates for that vertex. When working with a modeling view work area, you can move a geometric object into the graphing work area. The object remains a geometric object, and is not associated with the axes.

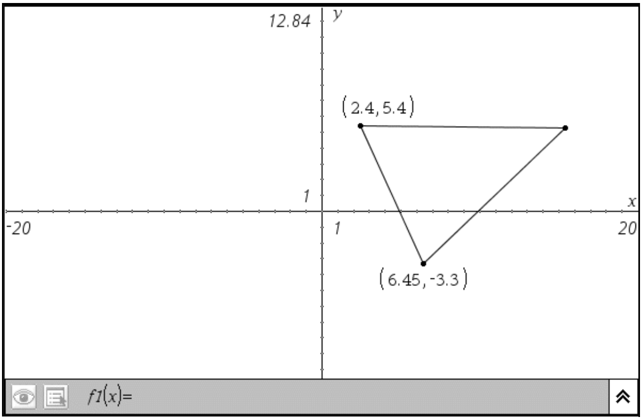
The examples below shows a modeling work area and the two types of objects: A is an analytic object while B is a geometric object.



While the two circles appear identical, they do not behave in the same way. Analytic objects are impacted when the graph area is altered. In the next example, the axes were altered. Notice that only Circle A’s appearance is affected by the change.



If you construct an object while the axis is hidden, the object created will be a geometric object. However, if you construct an analytic object and later hide the axis, the object remains an analytical one.



Triangle as it appears in Graphing view. The unlabeled vertex remains a geometric point.

Summary of differences

Feature	Graph Area	Plane Geomety Area
Aspect Ratio	Adjustable; initially 1:1	Always 1:1 (static)
Units of Measure	Generic (displayed as *u*)	User-defined (per scale)
Area Graph Type	Cartesian	Euclidian
Uses	• Define and graph functions • Create scatter plots • Define and graph parametric functions • Construct analytic objects • Label equations • Identify coordinates for discrete points	• Construct Euclidean objects • Create transformations • Determine measurements (e.g., length, angle, area)
Behavior	Analytic constructions must remain in the analytic area.	Geometric constructions can be moved into the analytic area but remain geometric in nature.

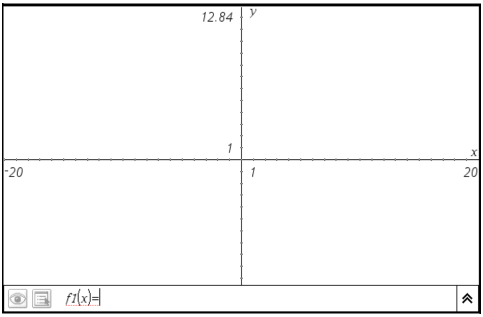
Creating and manipulating axes

When you add the Graphs & Geometry application to a page, a set of Cartesian axes displays.

You can change the appearance of your axes in the following ways:

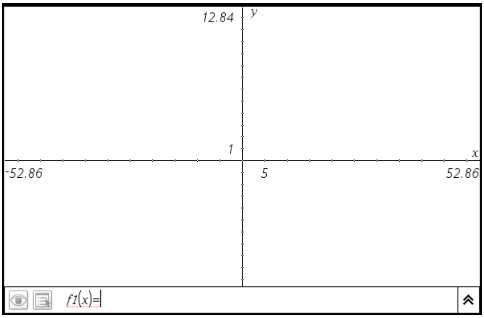
1. Adjust the length:
    - Select one axis and retype the domain or range labels.
    - Select one axis and drag the line to the desired length.

    The aspect ratio of the axes is retained. To modify the scale of only one axis, press the Shift key as you adjust the value or drag the line.



Default range and domain

Extended domain



2. Use the Zoom tool options. The Window Settings option lets you define *x*-min, *y*-min, *x*-max, and *y*-max values for the axes.

3. Adjust the end style of the axes using the Attributes tool. Display the Attributes tool by:

   - selecting it from the menu or
   - pressing ctrl + clicking on an axis between two tick marks.

   Press the left and right arrow keys to display the desired end style. The attributes list for the axes also enables you to select a Zoom option.

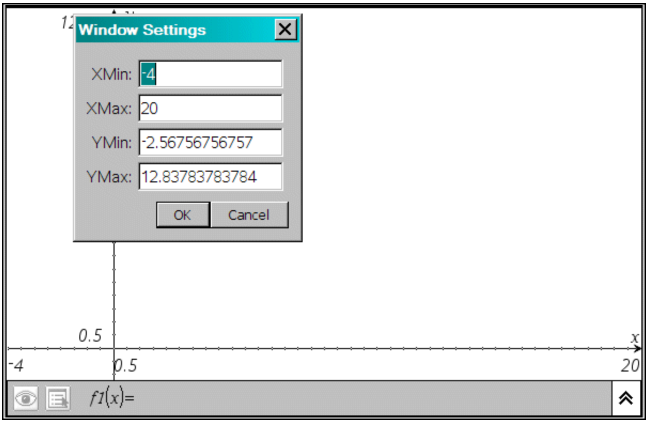
4. Adjust the axes scale and tic mark spacing.

   a) Click and hold one tic 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 CAPS ⇧, and then grab and drag a tic mark on that axis.

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. Use the Window Setting tool ( ) to define the x-max, x-min, y-max and y-min values for the axes. When selected, this tool opens a dialog that enables you to enter the values desired. The current values are initially displayed. Type over them to enter new values.



Window Settings dialog with initial values displayed

You can hide and redisplay axes using the Hide/Show Axes tool.

► From the View menu, select the Hide/Show Axes tool ( ).

  Press menu 2 4.

  • 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.

Moving about the work area

Graphs of functions may extend beyond the visible portion of your screen. This does not mean they are truncated. You can view them by panning the screen. To pan the screen:

1. Click and hold the mouse button in an open area of the page.
2. Move to display different portions of the screen.

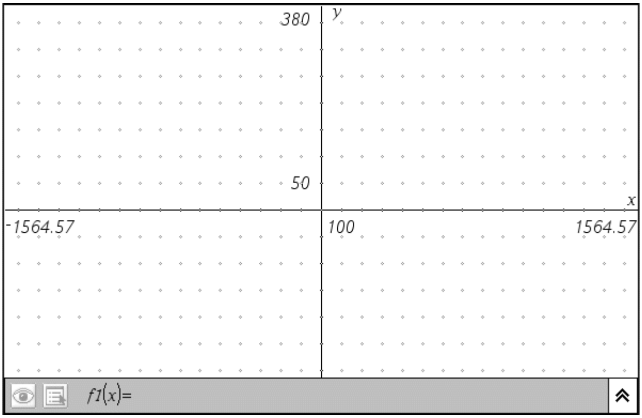
Turning the grid on or off

Graphs & Geometry can display a grid in addition to the axes. You control the sizing of the grid as well as whether or not it is visible.

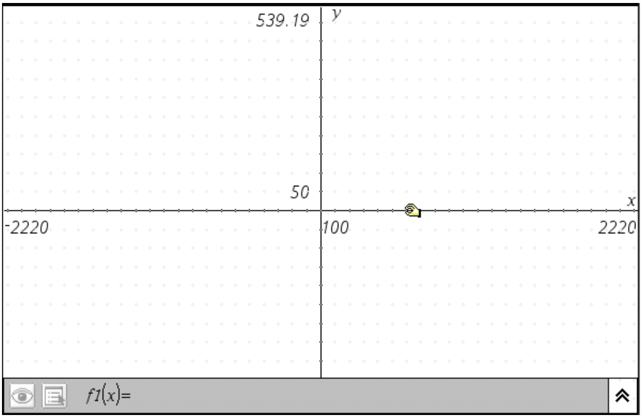
To display the grid:

▶ From the View menu, select the Show Grid tool ( ).

Press menu 2 5.



You resize the grid by rescaling the axes.



To turn the grid off:

▶ From the View menu, select the Hide Grid tool ( ).

Press menu 2 5.

When the tool is selected, the page updates to remove the grid.

In addition, you can attach a function, graph, or object to the grid while the grid is displayed.

Attaching an object to the grid

1. Display the grid on the page if it is not already present.
2. Draw an object on the grid.

   Points of the object must coincide with grid marks. For example, if you draw a triangle, then one or more of the vertices must coincide with grid marks.

Note: You do not have to attach an object or graph to the grid. When you attach an object to the grid, its subsequent relocation is constrained to other grid points. Analytic objects are affected by axes changes regardless of whether or not they are attached to the grid.

There is no way to unattach an object that is attached to the grid except by redefining it from the analytic to geometric zone. If you hide the grid, objects attached to it remain displayed on the page and remain attached to the grid even though it is no longer visible.

The Zoom feature

For screens with many function graphs, it can be difficult to view intersections and other areas of interest. To temporarily change your view of the screen, use the Zoom feature.

To use Zoom:

1. Open the Window menu.

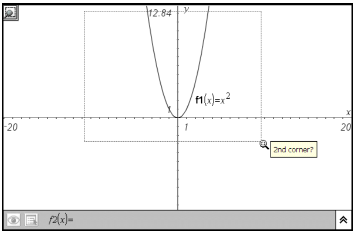
   Press (menu) (4).
2. Click the Zoom option you want to use.

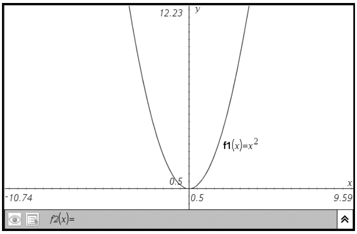
   In the following examples, all options except Zoom-Fit started with the graph of x^2. Zoom-Fit shows a graph of a sine function.

   The options are:

   - Zoom - Box

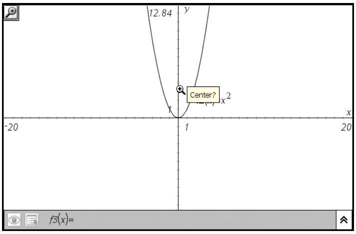
     Press (menu) (4) (2).

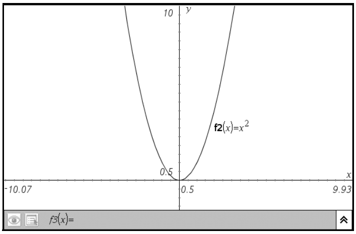




- Zoom - In

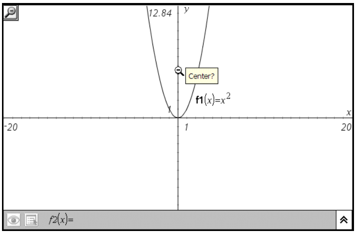
  Press menu 4 3.

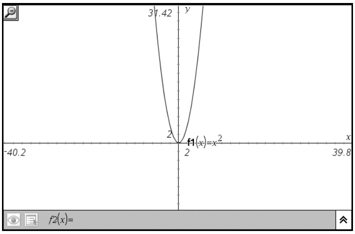




- Zoom - Out

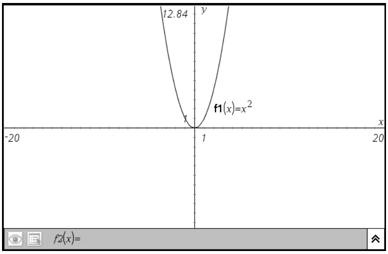
  Press menu 4 4.





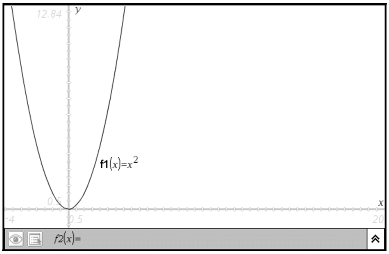
- Zoom - Standard

  Press menu 4 5.



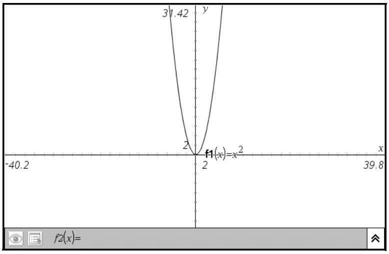
- Zoom - Quadrant 1

  Press menu 4 6.



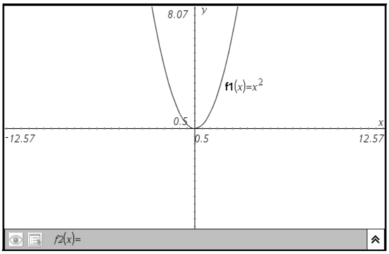
- Zoom - User (appears the same as Zoom - Standard if no new configuration is saved)

  Press menu 4 7.



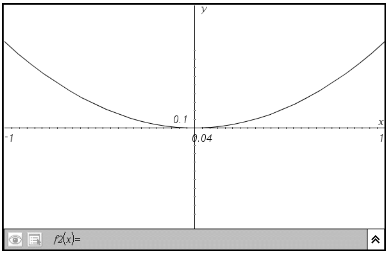
- Zoom - Trig

  Press menu 4 8.



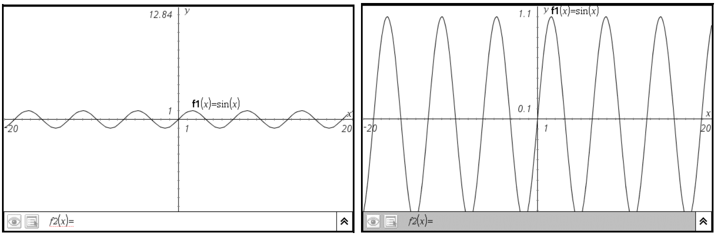
- Zoom - Data

  Press menu 4 9.



- Zoom - Fit

  Press menu 4 A.



3. The graph displays in the selected zoom view.

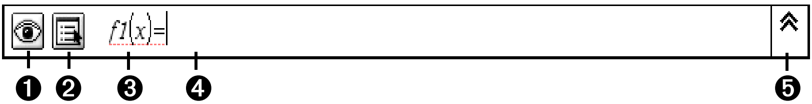
   If you select Zoom Box, you must specify the first and third corners of the box.

   If you select either Zoom In or Zoom Out, you must specify the center point before the graph is redrawn.

4. To return the graph to its initial state, either select Undo ( ) or select Zoom - Standard from the Zoom menu.

The entry line

The Entry line appears at the bottom of the Graphs & Geometry work area. When the line is not active, it is light grey in color.



From left to right, the parts of this line are:

❶ Hide/Show function button.

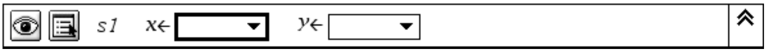
❷ Attributes button.

❸ f1(x)=. function notation used by the function or inequality.

❹ Blank area into which you enter the function, inequality, parametric or scatter plot data to be graphed.

❺ Expand/Contract (History) button.

Parametric Mode entry line. The default values for t-min, t-max, and t-step are



Scatter Plot Mode entry line

Additional Graphs & Geometry features

Keystroke shortcuts

There are keystroke shortcuts that can simplify your work with Graphs & Geometry. These are:

Keystrokes:	Task accomplished:
clear	Removes a selected object from the work area.
CAPS	When used with the Line or Circle tool, constrains Circle and linear objects (Line, Ray, etc.) construction to discrete intervals (e.g. Circle to integer radius values' linear objects to multiples of 15 degrees).
+ (+) - (-)	When a number is under the pointer, the + and - keys enable you to change the number of displayed digits.
< >	When a number is under the pointer, the < and > keys decrease or increase a value.

Using the tab and arrow keys

While the pointer allows you to access the many features and tools contained in Graphs & Geometry, you can also use the tab and arrow keys to access these features. Using these keys is easier or more convenient than using the pointer.

The tab key:

- First tab stop: places the cursor to the right of the equal sign on the function entry line. This allows you to create a new expression.
- Second tab stop: highlights the Expand/Collapse entry line history button.
- Third tab stop: highlights the Hide/Show button on the entry line.
- Fourth tab stop: highlights the Attributes button on the entry line.
- Fifth tab stop: focuses on the Pause/Start button of the animation control bar, if present. If the Data Collection control bar is displayed, focuses on the Start/Stop button.
- Sixth tab stop: focuses on the graphing portion of the page and commits any editing changes. The pointer is active on the page.

Note: Press CAPS tab to move through the steps in reverse order.

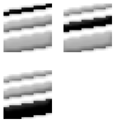
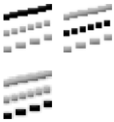
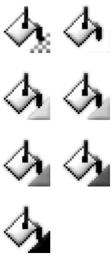
The arrow keys:

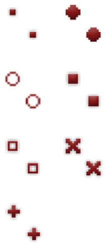
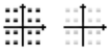
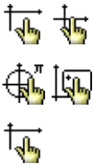
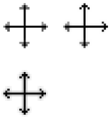
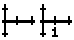
- Up and Down - moves up and down the function history list when the list is expanded. Moves up and down any tool menu list as well as the attributes list. When using the Trace tool, enables you to move to and trace a different graph when more than one graph is on the page.
- Left and Right - moves along the entry line, one space or one button at a time. When using the Trace tool, moves the trace cursor along the graph, either left or right. When viewing an attribute list, steps through the options for one attribute.

Attribute settings

The following table lists the attributes available when working with objects. The list of available attributes depends upon the object you select. To view attributes, select the Attributes tool ().

When the tool is selected, move the cursor to the work area and select the object or function whose attributes you want to change. The column of attributes available displays on the work area near the object or function.

Name	**Icon(s)**	**Options**	**Available for use on**
Line Thickness		Thin, Medium, Thick	Line, Tangent, Segment, Ray, Vector, Circle, Triangle, Polygon, Regular Polygon, Rectangle, Graphed Functions, Integrals
Line Style		Solid, Dashed, Dotted	Line, Tangent, Segment, Ray, Vector, Circle, Triangle, Polygon, Regular Polygon, Rectangle, Graphed Functions, Integrals
Animation		Unidirectional Animation Speed, Alternating Animation Speed	Point, Point On
Fill		No fill, White, Light Grey, Med Grey, Grey, Dark Grey, Black	Circle, Triangle, Polygon, Regular Polygon, Rectangle, Integrals
Lock/ Unlock			Point, Point On, Intersection Point, Length, Perimeter, Area, Angle

Name	Icon(s)	Options	Available for use on
Point Style		Small dot, Large dot, Hollow circle, Solid square, Hollow square, x, +	Point, Point On, Intersection Point
Activation		Point Activated, Point Deactivated	Points
Function Graph Appearance	 n= S=	Continuous, Discrete, Number of Points, Step Size	Graphed functions, Parametric curves
Axes Style		Cartesian Grid, No Grid	Axes
Axes Settings		Axes user settings, Axes Quadrant 1 settings, Axes Trig settings, Axes Stat settings, Axes standard settings	Axes
Axes End Style		No Arrow, Positive Arrows, All Arrows	Axes
Axes Tic Labels		Tic labels are shown, Tic labels are not shown	Axes
Line Equation Type	y=... ...=0	Cartesian (y=_), Canonical (_=0)	Line, Tangent, Segment, Ray, Vector
Equation Type	...=r^2 ...=0	Canonical (...=0), Cartesian (...=r^2)	Circle

Name	Icon(s)	Options	Available for use on
Plot Points		Discrete Points, Connected Points	Parametrics, Scatter Plots
Labels	f f( ) f()=.. y=f() y=...	y=, f( ), f( )=, y=f( ), f	Graphed Functions

Changing the thickness and style of a line/outline

You can control the thickness and appearance of the lines and outlines of shapes that you create on the screen. To adjust the thickness of the lines:

1. From the Tools menu, select the Attributes tool ( ).

   Press menu 1 3.

2. Select the object whose line you want to change.

   Use ▲ and ▼ to move through the list of attributes.

3. Highlight the thickness option, and use ◀ or ▶ to move through the thickness options.

   As you move through the options, the thickness immediately changes on the screen.

4. When the desired thickness displays on the screen, press enter or click to confirm the change.

   The Attributes bar disappears.

Use the same method to change the style of the line, selecting the style attribute, instead of the thickness attribute.

Locking measured values and points

Graphs & Geometry allows you to lock one or many values or points. To do this:

1. From the Tools menu, select the Attributes tool ( ).

   Press menu 1 3 .

2. Select the value or point that you want to lock.

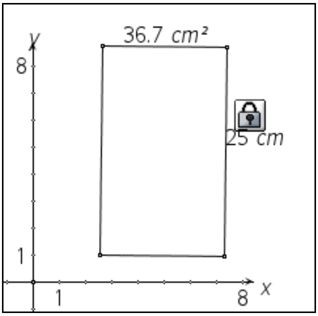
3. Use ▲ and ▼ to locate the Lock attribute.

4. Use ◀ or ▶ to select Lock.

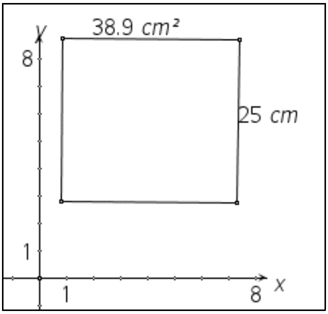
5. Click or press enter to lock the value or point.

   A lock icon appears near the locked value or point.

An example of when locking measured values is useful is the problem of maximizing an area contained within a fixed perimeter. In this case, a rectangle is created with the correct perimeter, and both the perimeter and area values are displayed. The perimeter value is locked. As you alter the sides of the rectangle, the perimeter remains unchanged but the area changes. When the optimum area displays, you can measure the sides to obtain the necessary dimensions.



Initial rectangle with locked perimeter



Optimized area with same initial perimeter

Working with functions

Graphs & Geometry can comprehend and graph several function types.

Using the entry line

The entry line displays at the bottom of the page. To enter a function on this line:

1. Select the mode.

   a) The default mode for this line is *f1*(*x*)=. If you want to enter a parametric function, select Parametric from the Graph Type menu.
   Press menu 3 2.

   b) To graph a scatter plot, select Scatter Plot.
   Press menu 3 3.

2. Type the function you want to graph in the space at the right of the = sign.

3. Press enter or tab.

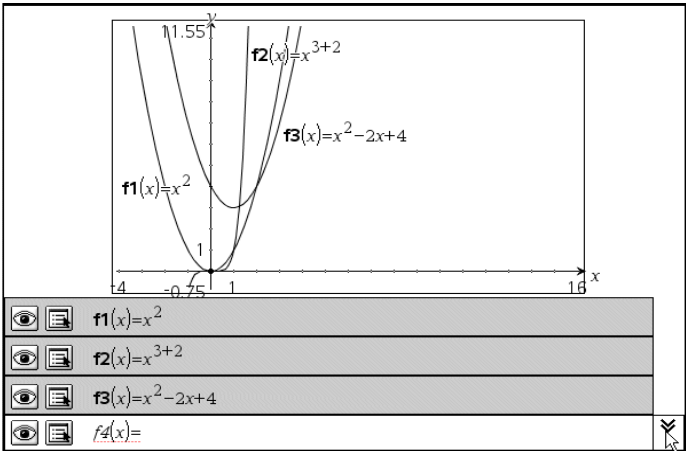
When f(x) is graphed, the entry line changes to *f2*(x)= to enable you to enter another function.

As you graph multiple functions on one set of axes, Graphs & Geometry labels each with its function. You can enter and graph a maximum of 99 functions on the screen (*f1(x)* - *f99(x)*) in addition to any user-named functions such as *g1(x)*.

Note: If you draw a geometric figure, the entry line may disappear from the page. Press ctrl G to select the Show Entry Line tool ( ).

Using the entry line expand button

You can review the functions entered on the page by pressing the Expand button. Expanding the entry line displays a line-by-line history list of the functions entered on the screen. The list displays functions in the order of entry (top to bottom), with the most recent entry closest to the entry line. Use ▲ and ▼ to move up and down the list.



Use the function history to edit, change the attributes of, delete, or hide (or redisplay) a specific function or graph.

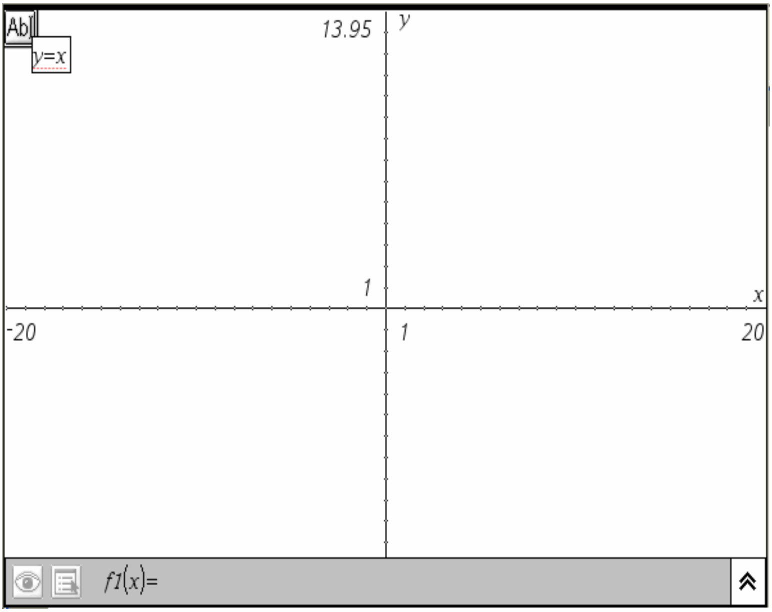
Using the Text tool to enter functions

You can graph functions, including functions of the form "y=", by typing them into a text box. To graph a function this way:

1. From the Tools menu, select the Text tool ( ).

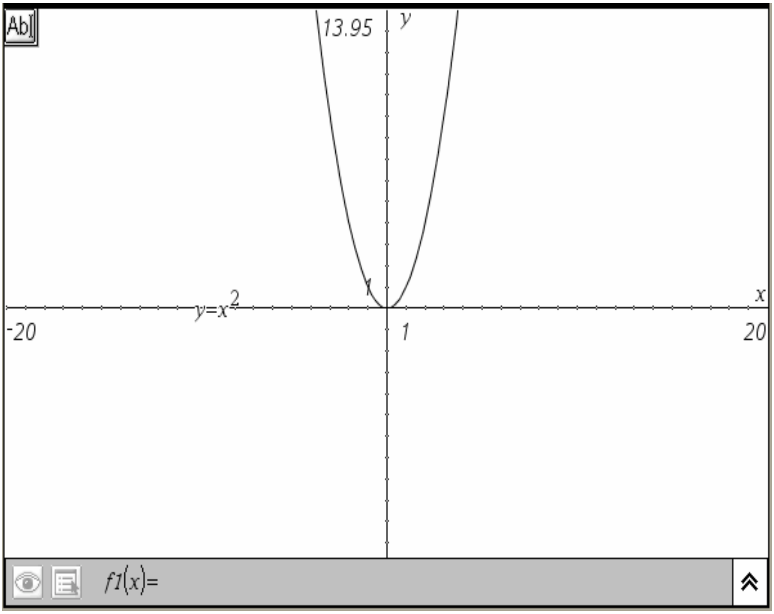
   Press menu 1 5.

2. In the box displayed, type the function you want to graph.



3. Drag the text box to the x-axis, and drop it on the axis.

   Graphs & Geometry graphs the function on the axes.



Regardless of how you enter functions, each function is labeled on the graph for identification.

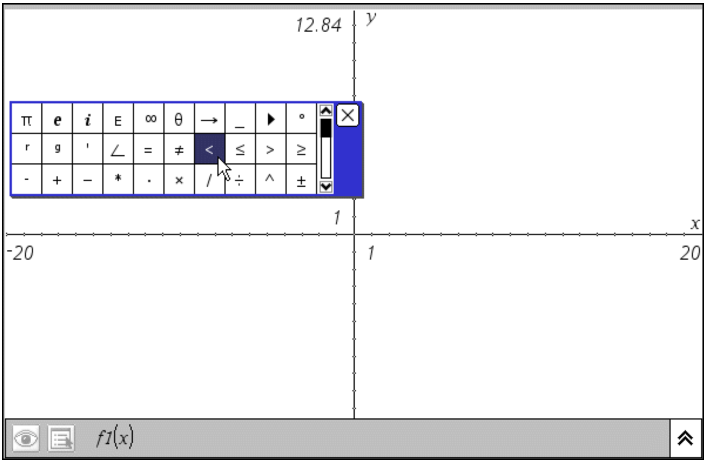
Graphing inequalities

Sometimes a function requires something other than the equal sign. To change = to a different sign and graph the inequality:

1. Position the cursor to the right of the equal sign.

   Press [clear] to delete the equal sign.

2. Type the desired sign or use the Symbol Palette to enter the appropriate inequality. The possible inequalities are: >, <, ≤, ≥, ≠.



3. Type the rest of the inequality expression.

   Press enter to graph it.

   The expression, as typed, displays next to the graph. Shading is always present on the graphs of inequalities to show the values that satisfy the inequality. If you graph two inequalities that overlap, the area of overlap is shaded darker than either of the individual inequality graphs.

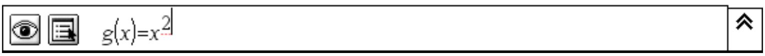
Renaming f(x)

fn(x) is the default naming convention for functions and inequalities entered into Graphs & Geometry. The number, represented by n, increases as you enter more functions.

To change *fn(x)* on the entry line:

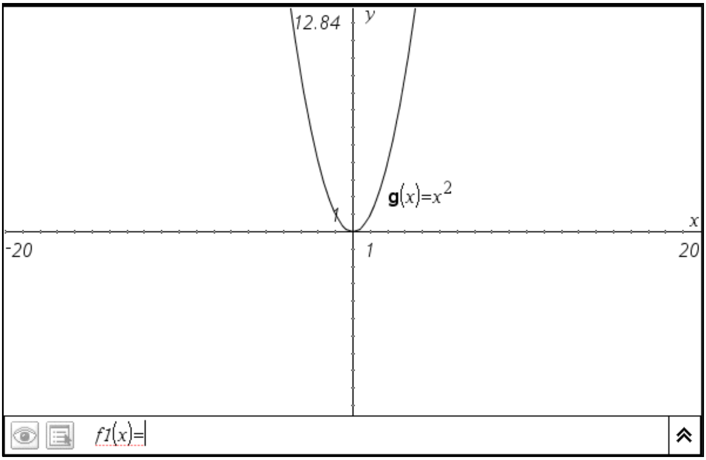
1. Place your cursor to the right of the = sign in the entry line.
2. Press clear until the line is blank.

3. Type the letters/numbers for the system you want to use, and then type the function or inequality you want to enter.



4. Press enter to graph the function.

Notice that the label shown next to the graph is identical to what you entered.



Note: When you use a customized naming convention, you must manually rename each function or inequality entered to continue the custom naming convention.

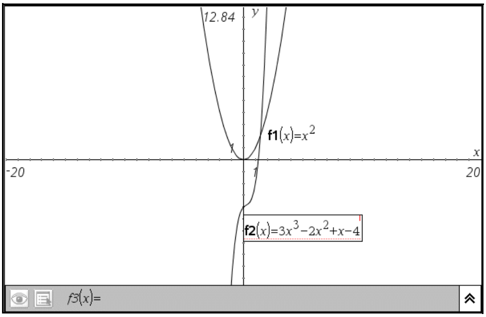
Editing functions

You can edit graphed functions, one function at a time. To edit a function:

1. Use one of the following methods to access the function:

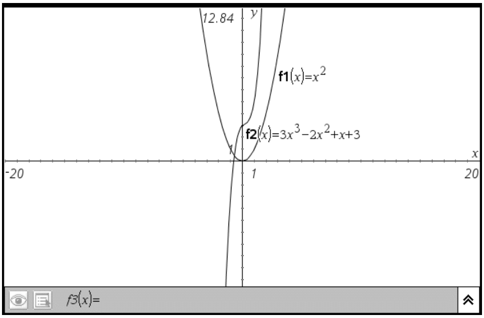
   - Press (esc) and double click the function label on the graph.
   - Select the entry line Expand button and highlight the function in the history listing.

   The expression displays in a text box, ready to edit.



2. Move the cursor to the portion of the function you want to change.
3. If you are adding to the expression, type the new characters into the function.

   If you need to delete a portion of the function, remove the unneeded characters then retype any new characters.
4. Press enter to graph the revised function.

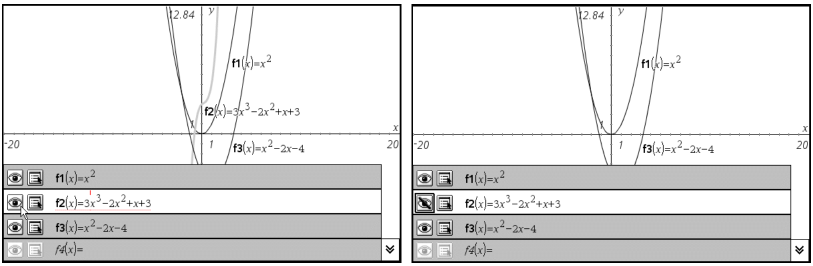


Hiding a function on the work area

1. Click the Expand button or press tab until the Expand button has focus, and then press enter to display the function history list.
2. Use the function history list to locate the function you want to hide on the work area.
3. Click the Hide/Show button ( ) to the left of the function.

   The graph of the function as well as its label are hidden on the screen. The Hide/Show button appearance also changes in the list to indicate it is hidden from view.

To redisplay the function, repeat the steps above.



Deleting a function

To remove a function from your graph:

1. Select the function by clicking on its graph.

   You can also select a function by using the Expand button to list all functions on the work area, then selecting the function in the list.

2. Press clear.

   The function is removed from the page and from the list of graphed functions.

Clearing the work area

1. To remove all functions and objects from the work area at one time, select **Tools > Delete All**

   Press menu 1 4.

   The system displays a delete confirmation box.

2. Select **Yes**, and all objects and functions are deleted.

   The axes remain displayed.

The Trace tools

Graphs & Geometry provides two trace tools:

- Graph Trace - point-by-point trace of a function graph.
- Geometry Trace - trail of functions or objects.

There is also an Erase Geometry Trace tool. This removes all geometry trace echos from the work area.

Using Graph Trace

Using the trace tool is another method of moving about a function, parametric, or scatter plot graph. To enable the trace tool:

1. Select the Graph Trace tool ().

   Press menu 5 1.

   The trace point displays on the graph.

2. The trace cursor can be moved in several ways:

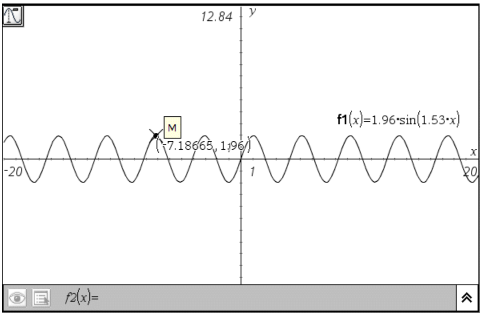
   - Press ◄ ► to move along the function's graph. The coordinates of each point displays during the trace.

- Press ▲▼ to move from one function graph to another or to a scatter plot. 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 that *x* value on the function's graph.

Notes:

- – When you trace beyond the initially visible graph, the screen pans to show the area being traced.
- – To create a persistent point while in Graph-Trace mode, press enter.
- – As you approach points of interest such as the maximum or minimum, the one-letter designator and the point's coordinates display. These disappear once you move the trace point beyond them.
- – If you select another tool, Graph-Trace becomes inactive.

To exit Graph-Trace mode, press esc.



Trace point on a sine graph. Notice the M (maximum) on the display.

Using Geometry Trace

The Geometry Trace tool enables you to leave a visible trail of an object when it is moved on the work area. The movement can be done manually or by using the Animation tool.

Note: The trace trail cannot be selected or manipulated.

To use Geometry Trace:

1. Create an object or function.

2. From the Trace menu, select the Geometry Trace tool.

   Press menu 5 2.

3. Click the object or function. Either:

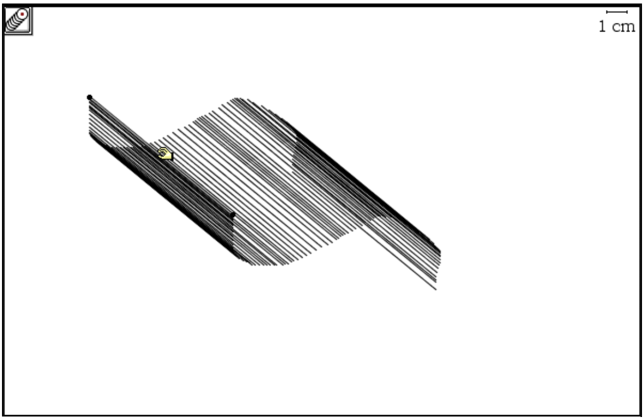
   - manually grab and move the object, or
   - select a point and animate it.

     If you use animation, the point must be selected for geometry trace as well as animation.

The amount of trace track displayed on the work area depends upon the amount of movement.

- If the object moves very little, then the entire track remains displayed until you erase it.
- If the object moves a lot, the track can obscure a significant portion of the work area. In this case, the older portions of the track fade out to prevent the work area from becoming obscured by the track.

In the following example, a line segment was drawn and selected for geometry trace. Movement of the segment was done manually.

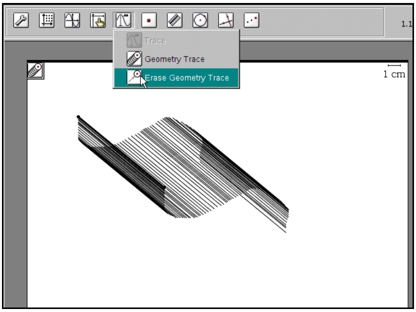


Using Erase Geometry Trace

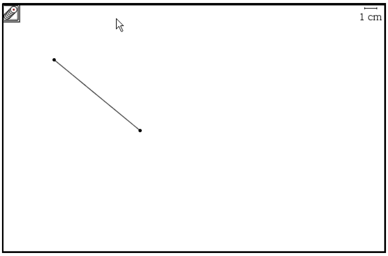
The easiest way to remove the trace tracks from the work area without deleting any objects or functions is to select the Erase Geometry Trace tool.

Press menu 5 3.

When selected, this tool removes immediately all trace tracks from the work area.



Erase Geometry Trace tool being selected.



Work area after trace track erased.

Manually manipulating functions

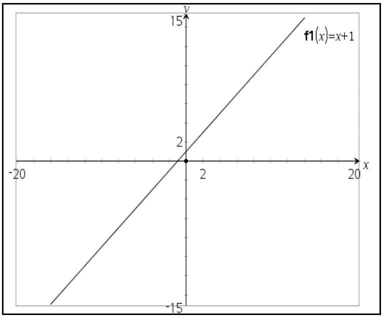
When you have graphed a function, you can use the Pointer tool ( ) to translate, stretch and/or rotate it by grabbing its graph. As you maneuver the graph, its symbolic representation also changes.

Press menu 1 1.

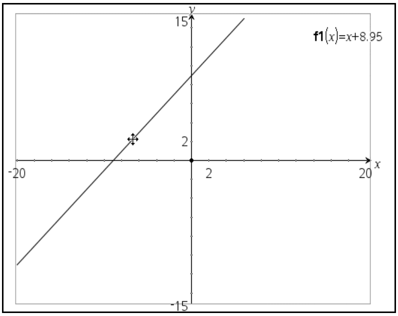
You can manipulate the following types of functions:

- Linear function; y=b
- Linear function; y=ax+b
- Quadratic function; $y=a(x-b)^2+c$
- Exponential function; y=exp(ax+b)+c
- Exponential function; y=b∗exp(ax)+c
- Exponential function; y=d∗exp(ax+b)+c
- Logarithmic function; y=a∗ln(cx+b)+d
- Sinusoidal function; y=a∗sin(cx+b)+d
- Cosinusoidal function; y=a∗cos(cx+b)+d

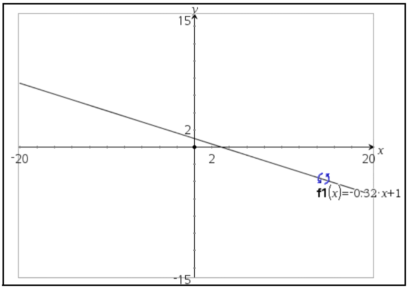
Manipulating a linear function



Initial function graph

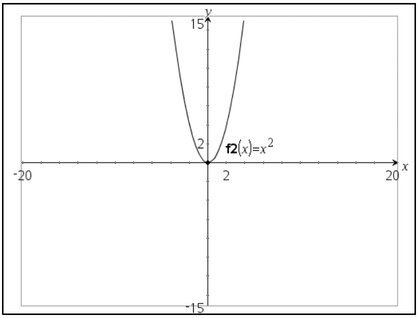


Function translated along the *x*-axis. (Notice the revised function label) To translate, “grab” near the middle of the graph then drag.

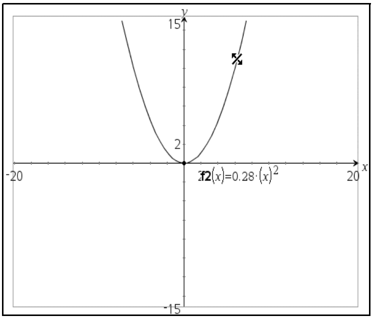


Manually rotated function. To rotate, “grab” near the ends of the graph

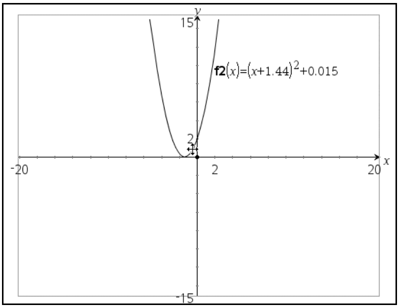
Manipulating a quadratic function



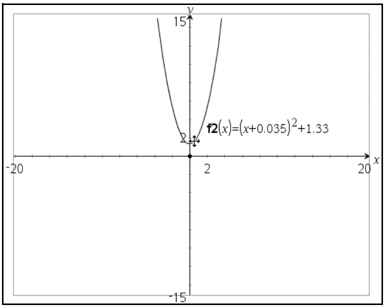
Original quadratic function



Manually rotated function. To stretch, “grab” away from the vertex of the graph then drag.



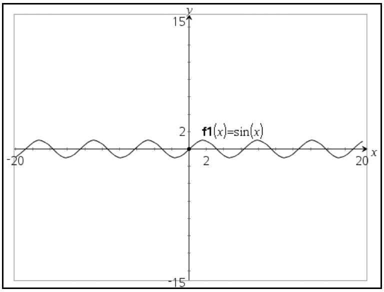
Function translated on the *x*-axis



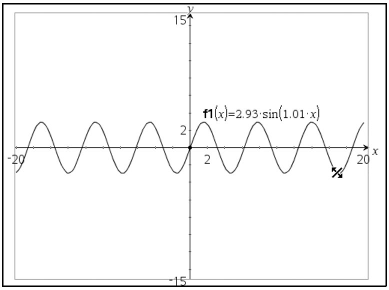
Function translated on the *y*-axis

To translate, “grab” near the vertex of the graph then drag.

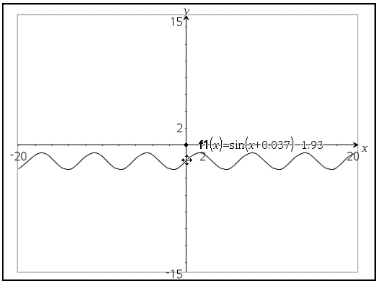
Manipulating a sine or cosine function



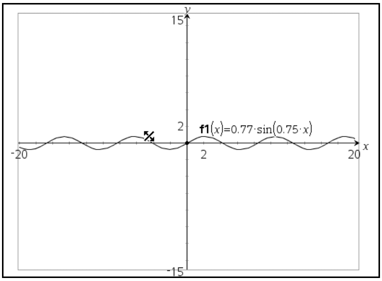
Original sine function



Rotation manipulation of the sine function. To stretch, “grab” away from the axis of vertical symmetry of the graph then drag.



Translation manipulation along the *y*-axis.



Translation manipulation along the *x*-axis.

To translate, “grab” near the axis of vertical symmetry of the graph then drag.

Working with multiple objects at one time

You can select multiple objects and perform the same actions on them.

Selecting multiple objects

There are two ways to select multiple objects. To select using the pointer:

1. Click the first object you want to select.
2. Move to the second object and click it.
3. Continue selecting objects in this way until all are selected.

   As each object is selected, its shape outline blinks.

To deselect objects:

1. To deselect one selected object, click the object again.
2. To deselect all selected objects, click on a space without any objects.

To select using a selection box:

1. Click once on a space without any objects.

   As you move the cursor, a box outline appears on the screen.
2. Move the cursor around the screen until all or a part of all the objects you want to select are contained in the box.
3. Click a second time to complete the selection box.

To cancel the selection box selections:

1. To cancel the selection box before it is completed, press esc or clear.
2. To cancel the selection box after it is completed, click on a clear space in the work area without any objects or press esc.

Deleting multiple selections

▶ To delete multiple selected objects, press the clear button on the Nspire device.

Note: The origin and the axes cannot be deleted even if they are selected for deletion.

Moving multiple selections

1. To move all selected objects, move the cursor to one of the objects.

   The cursor changes to indicate that the object can be grabbed.
2. "Grab" the object and move it to the new location.

All other selected objects will move along with the object moved by the cursor.

Note: If any non-moveable object is selected with moveable objects, then all objects must be moved individually. Examples of objects that cannot be moved in a multiple selection are objects attached to an axis, locked objects, and objects defined by one or more objects with a locked point or value.

Drawing and working with points and lines

In addition to graphing functions, you can also use the axes to draw points and lines. The types of points and lines you can create are:

- Points: Point, Point on, Intersection point(s)
- Labeling and naming a point
- Redefining a point
- Lines
- Rays
- Segments
- Segment with defined midpoint
- Parallel line
- Perpendicular line
- Vectors
- Tangent

Points

There are three tools for creating points:

- Point
- Point On
- Intersection Point

Creating a point

You can create an independent, moveable point using the Point tool.

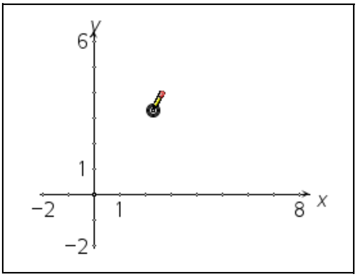
1. From the Points & Lines menu, select the Point tool ( ).

   Press menu 6 1.

2. Move to the work area, and click to create a point.

You can move the point about the graph using the Pointer ( ).

Press menu 1 1.



Note: Although two points define a line, you do not create lines with the Point tool.

Creating a point on a specific object

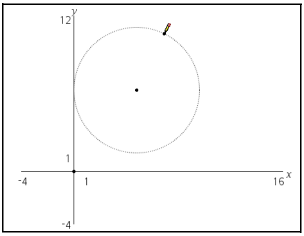
1. From the Points & Lines menu, select the Point On tool ( ).

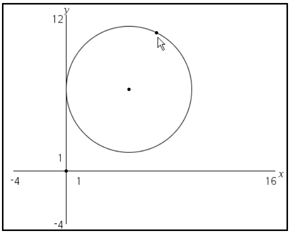
   Press menu 6 2.

2. Click on an object to create a specific point on the object.

   You can move the point about or along the object using the Pointer ( ).

   Press menu 1 1.





Defining an intersection point(s)

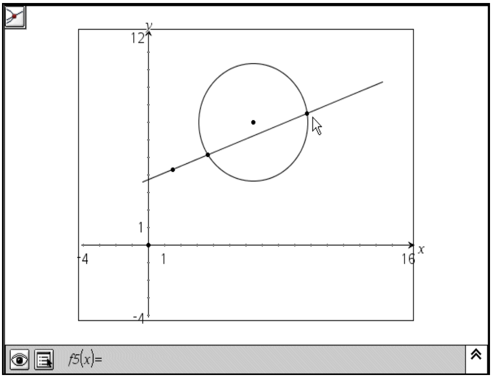
Note: To use this tool, two drawn objects must have one or more intersection points.

1. From the Points & Lines menu, select the Intersection Point tool ( ).

   Press menu 6 3.

2. Click on one object near its intersection with a second object.

The exact intersection point between the two objects is drawn. If the two objects intersect in more than one place, all intersection points are drawn.



Labeling (identifying) a point

You can identify the coordinates of any Analytic point (which you construct in the Graphing View, or within the Analytic Window of the Plane Geomtry View) using the Coordinates and Equations tool (). To label a point:

1. From the Graphing view, create a point if it does not exist.

   You can also select a point on an object using the Point On tool ().

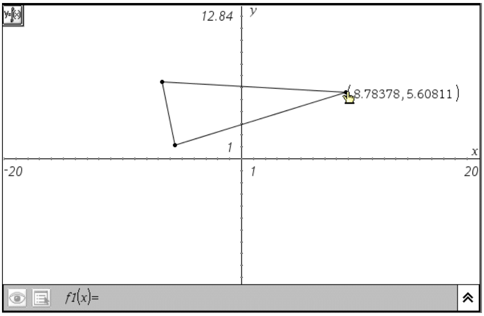
2. From the Tools menu, select the Coordinates and Equations tool ().

   Press menu 1 6.

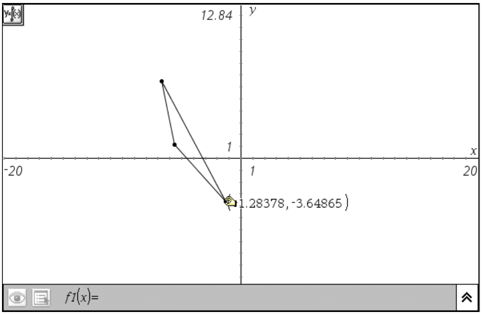
   Move the cursor toward the point's location, and the coordinates blink.

3. To add the coordinates to the work area, click to select the point and then press enter, or click the point to anchor the coordinates on the work area.

   The coordinates stop blinking and are displayed in parentheses. The format used is based upon the Locale you selected.



If you move the point to a different location, the new coordinates are updated to the new position.



Naming a point

You might not need to label a point but instead, you want to name it for easy reference. You can name points and vertices, regardless of the Graphs & Geometry work area view. Since they are not tied to a specific coordinate, names remain unchanged if you alter the location of any portion of an object. There are two methods for creating names.

1. One method is to use the Text tool (Ab) after you create an object.

   Press menu 1 5.

2. A second method is to name them as you create them. To add a name as you create an point, type a letter or name immediately after you define the point.

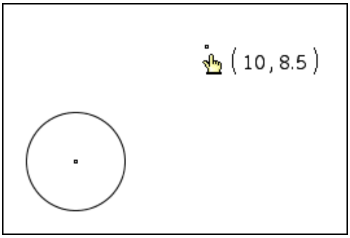
   For example, when creating a triangle, typing the letter “x” after creating the first vertex names that vertex “x”. The two remaining vertices can be named “y” and “z” in the same way when they are created.

Redefining a point

You can redefine a point from an open area to an object, from one object to another, or from the analytic to the geometric zone (or vice versa.) To redefine a point:

1. Create a point.

   (Note that in the examples, the point coordinates are labeled.)

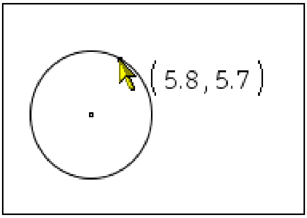


2. From the Tools menu, select the Redefine tool ( ).

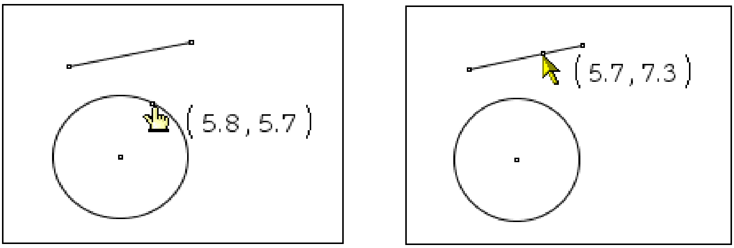
   Press menu 1 8.

3. Select the point to be redefined, then select the object.

   The point moves to the object.



Note: A point can be redefined from one object to another. The procedure is the same as described above.



In these examples, the point is redefined from the circle to the segment.

Linear objects

The linear objects you can create and explore are located on the Points & Lines menu. Graphs & Geometry creates “smart” lines and rays. This means that the meaningful portion of the line or ray is displayed rather than having the object project to infinity. This feature reduces clutter on the work area.

Creating a line

1. From the Points & Lines menu, select the Line tool ( ).

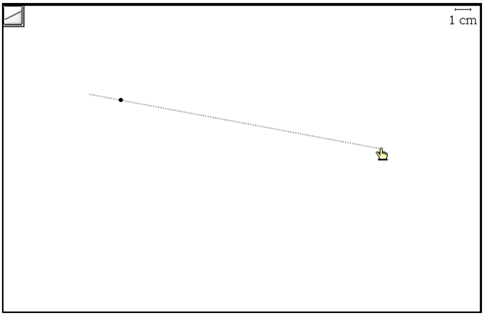
   Press menu 6 4.

2. Click a location to start your line.

   This click defines one point on the line.

3. Move and click again to define the direction of the line.

   Graphs & Geometry draws the line.



Note: If you hold down the CAPS key while creating the line, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.

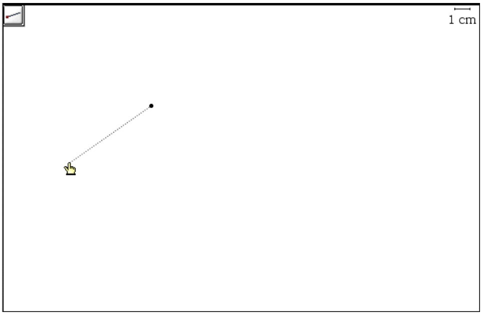
Creating a ray

1. From the Points & Lines menu, select the Ray tool ( ).

   Press menu 6 6.

2. Click to define the endpoint of the ray.
3. Move the cursor and click again to define the direction of the ray.

   Graphs & Geometry draws the ray.



You can create a ray anywhere in the work area, regardless of the axes' location.

Note: If you hold down the CAPS key while creating the ray, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.

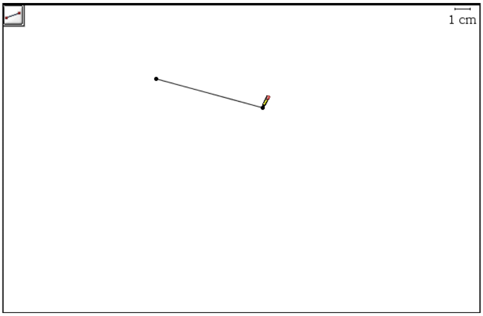
Creating a line segment

1. From the Points & Lines menu, select the Segment tool ( ).

   Press menu 6 5.

2. Click to define the first endpoint of the segment.
3. Move the cursor and click again to define the second endpoint of the segment.

   Graphs & Geometry draws the segment on the page.



Note: If you hold down the CAPS key while creating the segment, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.

Creating a line segment with defined midpoint

With the Midpoint tool ( ), you can define a midpoint:

- on an existing line segment,
- between two specified points on a line,
- between two points on a page as you create the points. The midpoint is located and identified between the points. When the second point is selected, the midpoint is also created on the page.

1. From the Construction menu, select the Midpoint tool ( ).

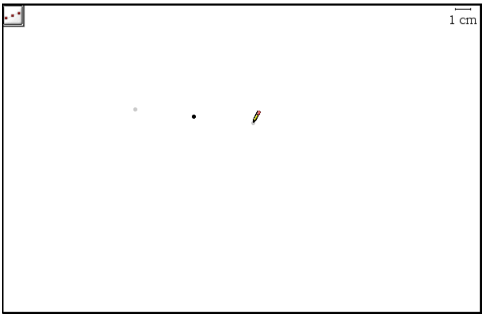
   Press menu 9 5.

2. Click at the location to start the segment.

   As you move the cursor on the work area, a second end point appears. In between the starting point and this end point, you will see the midpoint.

3. You can move the segment in any direction until you click on the work area a second time.

   With the second click, the segment is anchored and the midpoint remains identified.

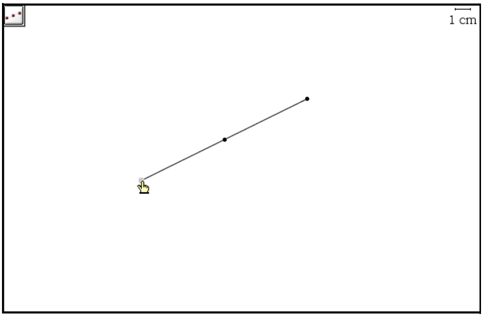


Midpoint defined between two points.

4. If you are defining the midpoint of a segment or a segment on a line, click at the first endpoint of the segment.

5. As you move the cursor along the segment or line, a second endpoint and the midpoint appears.

6. Click at the second endpoint to define the segment and anchor the midpoint.



Midpoint defined for an existing segment.

Repositioning segments with midpoints

1. To reposition the segment after placing it on the work area, click the Pointer tool ()

   Press menu 1 1.

2. Select the segment and drag it to a new location without changing its orientation or length, or select one endpoint and drag it to a new location.

   If just an endpoint is moved and if the length of the segment changes, then the midpoint is repositioned to remain at the middle of the segment.

Creating a parallel line

You can create a parallel line with respect to any existing line on the work area including the axes, and the side of any triangle, square, rectangle and polygon.

1. From the Construction menu, select the Parallel tool ().

   Press menu 9 2.

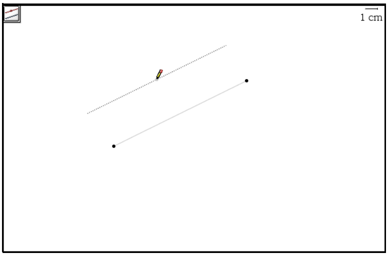
2. On the work area, click once on an existing line, segment, or axis.

   This click identifies the reference line for the new parallel line you are creating.

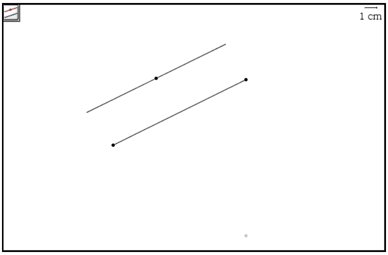
3. Move the cursor away from the reference line, axis, or segment.

   Notice that a dotted line displays, representing the parallel line.

4. When the dotted line is in the desired position, click again to anchor it on the work area.



Parallel line following cursor



Anchored parallel line

Note: You can also click first on the work area and then select the reference line to create the parallel line.

Creating a perpendicular line

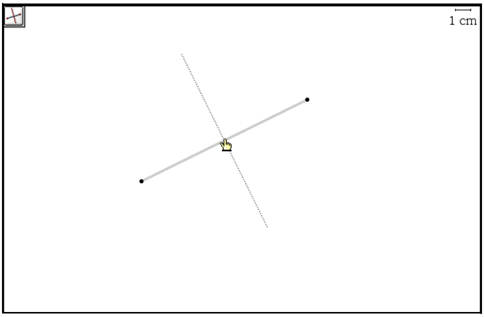
You can create a perpendicular line with respect to any existing line or segment in the work area including the axes, and the side of any triangle, square, rectangle or polygon.

1. From the Construction menu, select the Perpendicular tool ( ).

   Press menu 9 1.

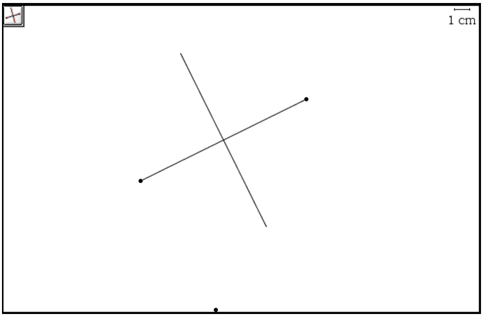
2. Move the cursor onto the work area, and double click the spot on the line or segment where you want to create the perpendicular line.

   This click establishes the intersection point on the original line or segment and the perpendicular line.



Perpendicular line before anchoring to page

3. Click again to anchor the perpendicular line.



Anchored perpendicular line

4. To move the perpendicular line to a different location on the reference line, select the Pointer tool ( )

   Press menu 1 1.

5. Click the intersection point and drag the point and perpendicular line to the new location.

6. Click again to anchor the line in the new location.

   Note: You can also click first on the work area and then click the reference line to create the perpendicular line.

Creating a vector

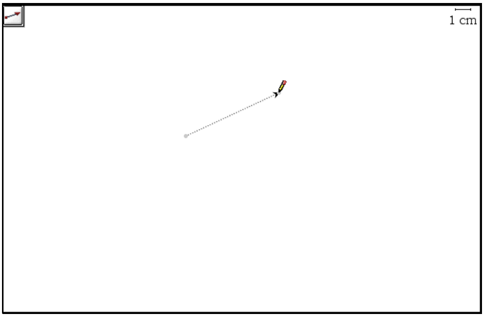
1. From the Points & Lines menu, select the Vector tool ( ).

   Press menu 6 8.

2. On the work area, click the spot from which the vector originates.

3. Move the cursor in the direction of the vector.

   A dotted line follows the cursor as you move about the area.

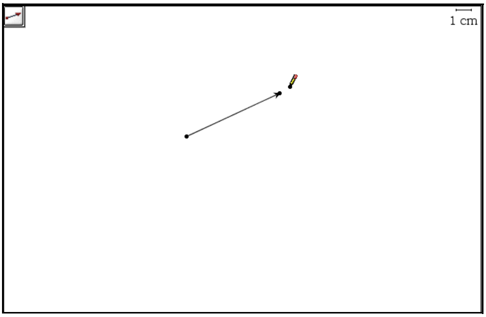


Vector following cursor after identification of endpoint

4. When the vector is in the correct position, click to anchor the vector on the work area.

   The dotted line changes to a solid line.

   Note: If you hold down the CAPS key while creating the vector, you limit its orientation, relative to the x-axis or the horizontal aspect of the screen, by 15° increments.



Vector anchored to page

Moving a vector

1. Select the Pointer tool ( )

   Press menu 1 1.

2. Click on any point other than the endpoint, and drag the vector.
3. When the vector is in the desired location, click to anchor it on the work area.

Resizing a vector

▶ Select the end point and drag it to the new location.

Note: If the endpoint is located on an axis, you can only move the endpoint of the vector along the axis.

Creating a tangent

You can create a tangent by identifying a specific point on an existing object or function. To create a tangent line:

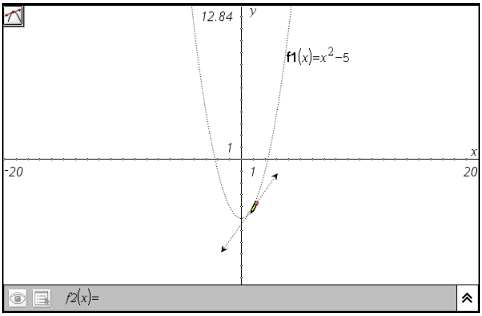
1. From the Points & Lines menu, select the Tangent tool ().

   Press menu 6 7.

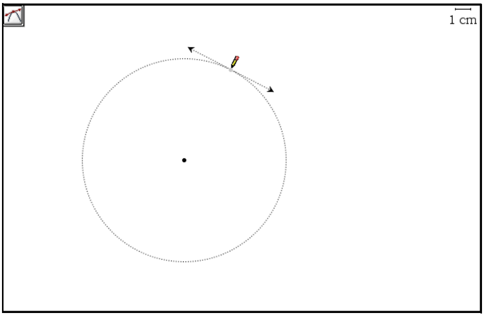
2. On the work area, select the point at which you want the tangent drawn.

   A dotted tangent line blinks on the work area.

3. Click or press enter to anchor the tangent on the work area.



Tangent of a graph



Tangent of an object

Creating and working with objects (shapes)

With Graphs & Geometry, you can draw:

- Circles
- Triangles
- Rectangles
- Polygons

- Regular Polygons

Creating a circle

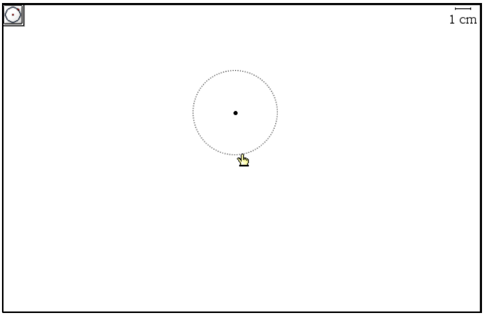
1. From the Shapes menu, select the Circle tool ().

   Press menu 8 1.

2. On the work area, click once to establish the center of the circle.

   Move the cursor away from this point.

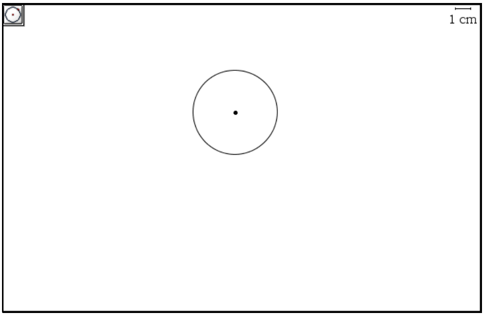
   You will see a circle with a dotted circumference line emerge as you move the cursor.

3. When the circle has the radius you desire, click again.

   The dotted circumference changes to a solid circumference in the work area.

   This second click does not define a point on the circumference; instead, it completes the circle construction.

Note: If you hold down the CAPS key when creating the circle, the radius is limited in length to integers.

Moving a circle

You can move the circle to a different location without resizing it,

1. Select the Pointer tool ( )

   Press menu 1 1.

2. Select the circle's center point.

3. Drag the circle to the new location.

Resizing a circle

1. Select a point on the circumference.

   The circumference line changes to a dotted line.

2. Move the dotted line until the circle is the desired size.

3. Click to anchor it in the work area.

Creating a circle with the Compass tool

You can also create a circle with the Compass tool.

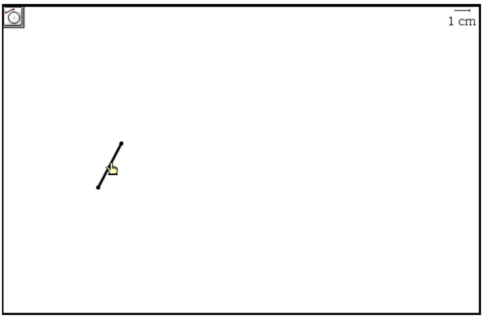
1. From the Construction menu, select the Compass tool ( ).

   Press menu 9 7.

2. Move the cursor to the page and

   - select the segment to use as the circle's radius or
   - define two points.

     The distance between these points will become the radius length for the circle.

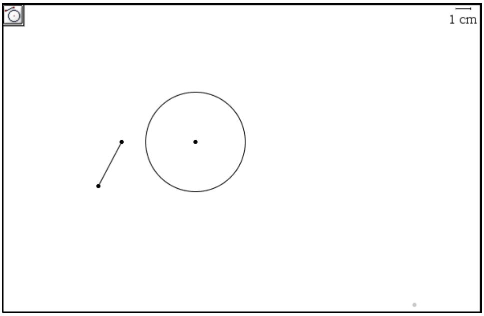


Segment selected for circle's radius.

3. When you select the segment, a circle displays with the center point positioned under the cursor.

4. Move the circle to the desired location.

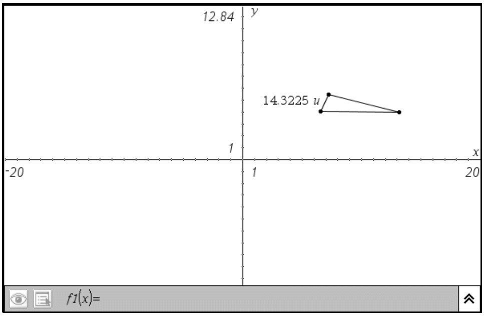
5. Click to change the circumference from a dotted line to a solid line and anchor the circle on the page.



Circle created with Compass tool and anchored on page.

You can use a measured length for the radius of a circle.

1. Select a segment or the side of a triangle or rectangle.
2. Measure the length, and display the length value on the page.

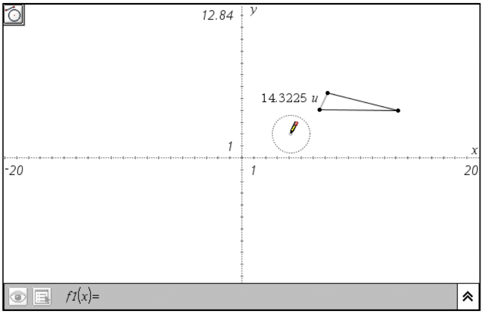


3. Select the Compass tool ( )

   Press menu 9 7.

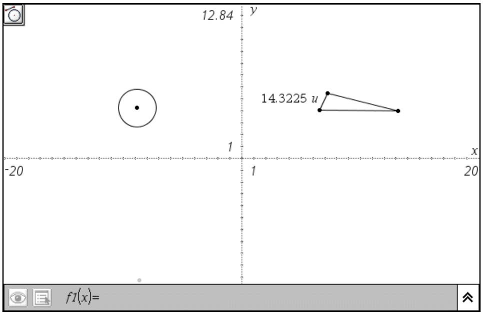
4. Click the length value.

   A circle with the radius of the selected length automatically appears.



5. Move to the desired location for the circle (it will follow as you move), and click to anchor it on the page.

   The circumference line changes from dotted to solid.



Creating a triangle

1. From the Shapes menu, select the Triangle tool ().

   Press menu 8 2.

2. On the work area, click once to establish the first vertex of the triangle.
3. Move the cursor to the location for the second vertex and click again.

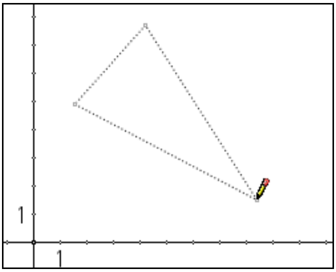
   Notice that the side of the triangle is shown as a dotted line.

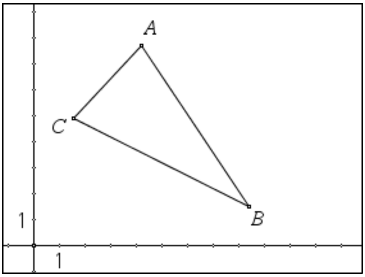
4. Move the cursor to the location of the last vertex.

   As you move the cursor, all sides of the triangle are shown as dotted lines.

5. Click again to create the final vertex and anchor the triangle on the work area.

The sides are defined by solid lines.





Moving a triangle

You can move the triangle to a different location without resizing it.

1. Select the Pointer tool ()

   Press menu 1 1.

2. Select one side of the triangle.
3. Drag it to the new location.

Reshaping a triangle

1. Click one of the three vertices.
2. Move the selected point until the triangle is the correct size.
3. Click again to anchor it on the work area.

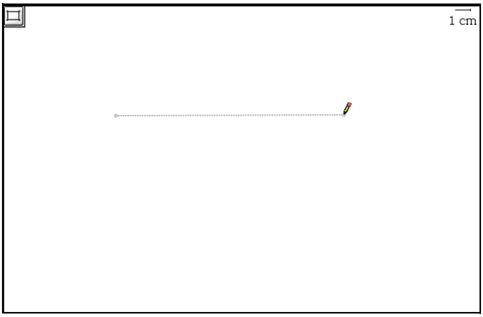
Creating a rectangle

1. From the Shapes menu, select the Rectangle tool ().

   Press menu 8 3.

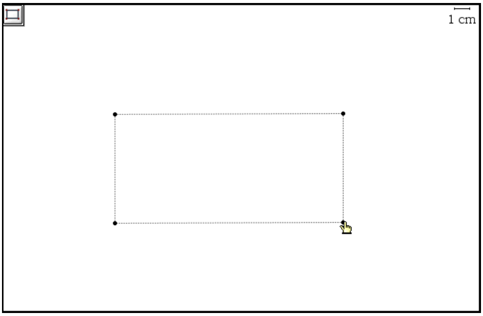
2. Click once to establish the first corner of the rectangle.
3. Move the cursor to the location for the second corner, and click again.

   One side of the rectangle is defined.

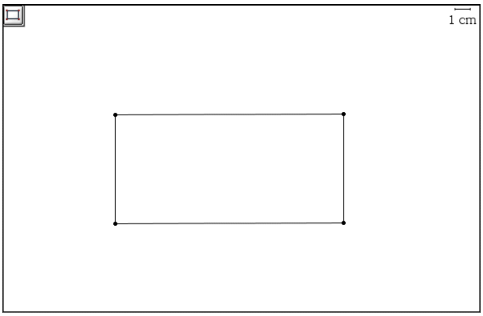


4. Move the cursor away perpendicularly from the side to the line.

   The outline of the rectangle appears on the screen.



5. When the rectangle is of the correct size, click again to anchor the rectangle to the work area.



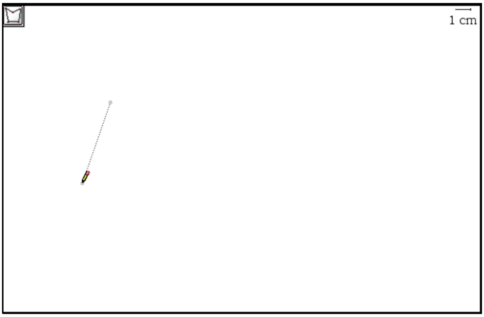
Creating a polygon

You can create a polygon by defining three or more connected points. While you can create a triangle using the Polygon tool (), using the Triangle tool () reduces keystrokes. To construct a polygon:

1. From the Shapes menu, select the Polygon tool ().

   Press menu 8 4.
2. On the work area, click once to establish the first point of the polygon.
3. Move the cursor to the location for the second point and click again.

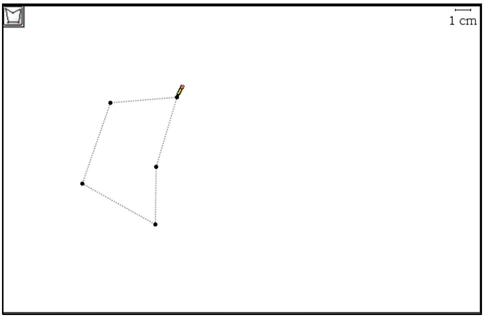
   Notice that the side of the polygon is shown as a dotted line.



4. Move the cursor to the location of the next point.

   As you move the cursor, the polygon’s sides display as dotted lines.

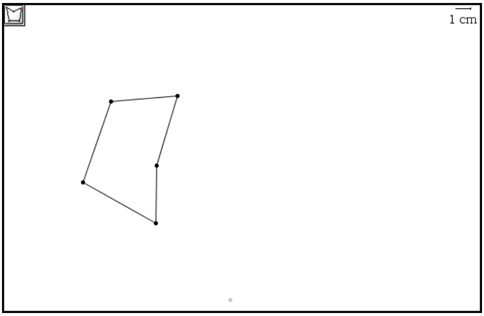
   Continue to move the cursor and click to create as many sides as needed.



5. To complete the polygon and anchor it on the work area, do one of the following:

- double click the final point,
- click on the initial point, or
- press enter.

The sides are defined by solid lines.



Note: If you create a polygon with all defined points colinear, then the construction is defined as a segment.

Moving a polygon

1. Select the Pointer tool ().
2. Select one side of the polygon.
3. Drag it to the new location.

Reshaping a polygon

1. Select one of the vertices.
2. Drag it to a new location.
3. Click to re-anchor it on the work area.

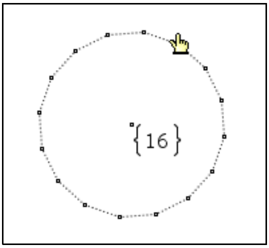
Creating a regular polygon

1. From the Shapes menu, select the Regular Polygon tool ().

   Press menu 8 5.

2. Click once on the work area to establish the center point of the regular polygon.
3. Move the cursor away from the center point and click on the work area again to establish the first vertex and radius.

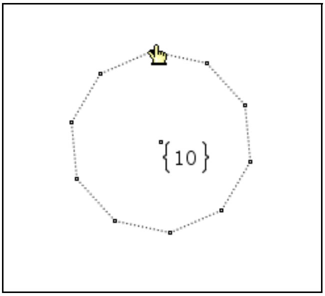
   A 16-sided regular polygon is formed. The number of sides displays near the center point in brackets; e.g., {16}.

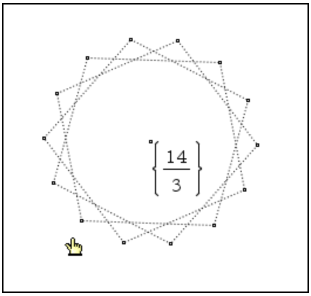


– To reduce the number of sides, select a vertex and move the pointer in a clockwise motion around the perimeter of the polygon.

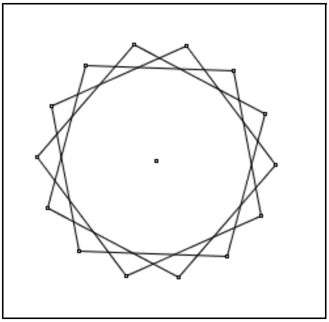
– To increase the number, select a vertex and move the pointer in a counter-clockwise motion.

Note: The number of sides of the polygon displays as you move the pointer.





4. When the desired number of sides displays, click to anchor the polygon on the work area.



Anchored regular polygon

Transferring Measurements

You can duplicate (transfer) a specific length to a new object using the Measurement Transfer tool ( ).

Press menu 9 8.

The objects you can transfer a length to are:

- a circle - the length transferred becomes the radius of the circle. You can also transfer a measurement onto a circle to define an arc.
- a ray - the length transferred starts at the endpoint and defines a second point on the ray
- a vector - the length transferred starts at the endpoint and defines a second point on the vector

You can also transfer a numeric text value to an axis.

Transferring a measurement

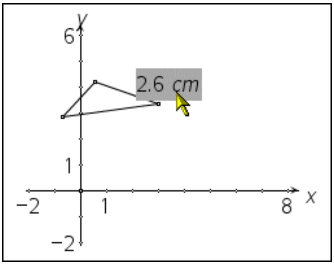
1. Measure and display the length or area that you want to transfer.

   If you want to transfer the measurement to a ray or vector, create these objects if they do not already exist on the work area.

2. From the Construction menu, select the Measurement Transfer tool ( ).

   Press menu 9 8.

3. On the work area, select the measurement value you want to transfer to a new object.



4. To create a circle, select the Circle tool ( )

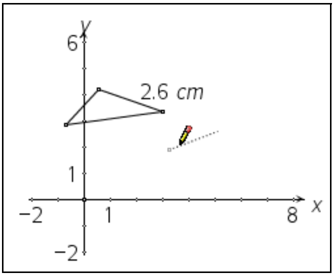
   Press menu 8 1.

   a) When you move to the work area, the circle immediately appears. Its radius is the transferred measurement.

b) Click to anchor the circle on the work area.

5. If you are transferring a measurement to a line, ray or vector, click on the object.

   The distance between the two defined points is the transferred measurement.



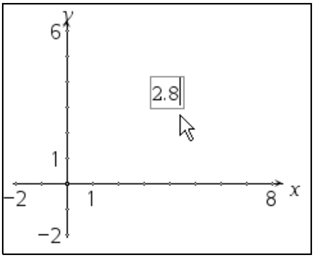
Ray created from the transferred measurement

Note: If you adjust the length of the initial measurement, all objects you create with that measurement are adjusted automatically to reflect the change.

Transferring a numerical text entry to an axis

1. Using the Text tool (Ab), create the number on the work area.

   Press menu 1 5.

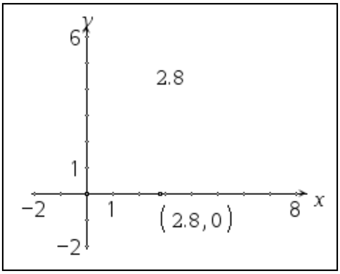


2. From the Construction menu, select the Measurement Transfer tool ().

   Press menu 9 8.

3. Select the created number, then click on the desired axis.

   The value is marked by the addition of a point on the axis. In the example below, this point is labeled to show its value.



Transferring a measurement onto a circle

1. Either enter a value using the Text tool (Abl), or display a measurement on the work area.

   Press menu 1 5.

   Create a circle using the Circle tool if one does not already exist on the work area.

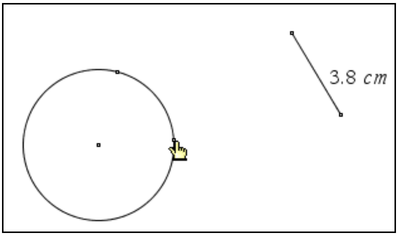
2. Select the Measurement Transfer tool (2.0) .

   Press menu 9 8.

3. Select the value and the circle.

4. Click on the circle a second time to define the starting point for the transferred measurement.

   The measurement is transferred in a counter-clockwise direction, and the starting and ending points of the value are marked by points. The arc defined on the circle has the same measure as the transferred value.



The segment length was transferred onto the circle. The two points on the circle define this length. The hand cursor shows the starting point for the transfer.

Note: If you measure the distance between the two points on the circle, the value will be less than the transferred measurement. The straight line between the points is measured, not the arc formed between the two points. The arc's length is the transferred measurement.

Measuring graphs and objects

You can obtain various measurements from the functions you graph and the objects you draw. These measurements include finding areas, perimeters, lengths, angles, and slopes. The metric system is the default for units of measurement. You can change the system by changing the mode settings for your document.

Note: Document settings are available under the **File** menu.

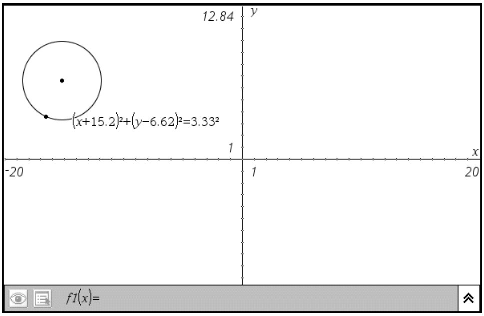
Identifying equations for circles and lines

You can display the equation of any Analytic object (constructed in the Graphing View, or within the Analytic Window of the Plane Geometry View) and label it on the screen. To do this:

1. On the Graph work area view, create a circle or line.
2. From the Tools menu, and select the Coordinates and Equations tool ( ).

   Press menu 1 6.
3. Click or press enter to select the circle or line.

   The equation for the circle or line displays and the object blinks on the screen.
4. Click or press enter to anchor the equation on the screen.



Note: If you approach a defined point on the line or the center point of a circle, the coordinates for that point display instead of the equation. Move the cursor away from the defined point to obtain the equation of the object.

Measuring length

You can measure the length of a segment, vector, distance between two points, distance from a point to a line/ray/segment/vector, and distance from a point to a circle.

Note: Measurements made on Graph view objects and lines have generic units, u. Measurements made on Plane Geometry view objects and lines have the unit value you create. The default unit value is cm.

1. From the Measurement menu, select the Length tool ( ).

   Press menu 7 1.

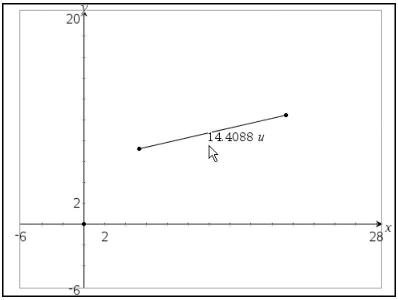
2. To measure a segment or vector:

   a) Click or press enter to select the object.

      The target segment or vector blinks.

   b) Click or press enter to anchor the measurement on the work area.

      Note that a line segment can be part of a triangle, rectangle, or polygon.



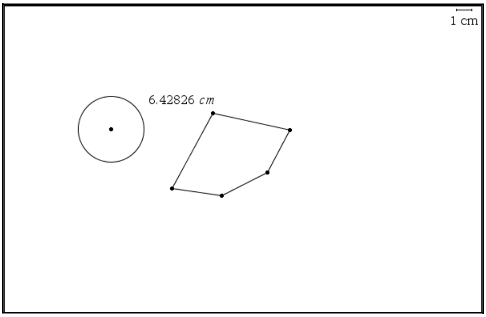
3. To measure the distance between two points, between a point and a line, or between a point and a circle:

   a) Select the first point.

   b) Select the second point or a point on the line or circle.

      The selected length blinks.

   c) Click or press enter to anchor the value on the work area.



In this example, length is measured from the center of the circle to the upper left vertex of the polygon.

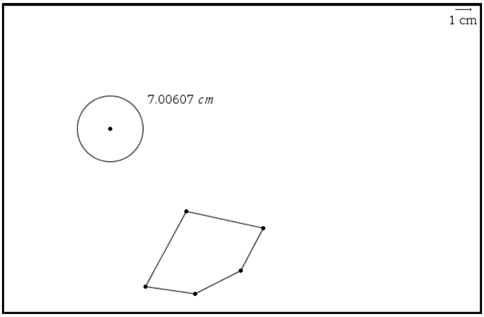
4. To measure the length of one side of a triangle, rectangle, or polygon:

    a) Select each endpoint of the segment.

    b) Click or press enter to anchor the value on the work area.

    Note: The value that displays when you initially approach the object (before selecting the endpoints of the side) is the perimeter of the object, not the length of the one side.

The measurement remains visible and close to the measured objects even if you move one or both of the objects or measurement points. If you move an object or point, the measurement updates to reflect the new distance.



Polygon moved on work area. Note the distance value reflects new distance.

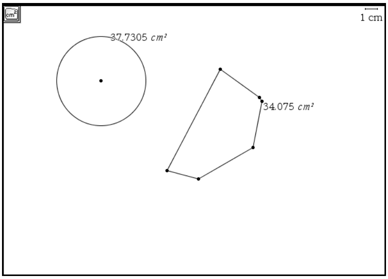
Finding the area of a circular disc, polygon, rectangle or triangle

1. From the Measurement menu, select the Area tool (cm²).

    Press menu 7 2.

2. On the work area, click or press enter to select the object.

3. To anchor the value on the work area, click or press enter.



The area of the circle and the polygon are shown in this example.

The measurement remains visible and close to the object even if you change the size of the object. If you alter an object, the measurement updates to reflect the new area value.

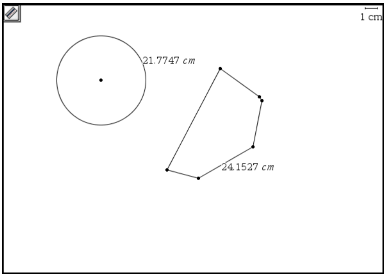
Finding the perimeter of a circular disc, polygon, rectangle or triangle

1. From the Measurement menu, select the Length tool ( ).

   Press menu 7 1.

2. On the work area, click or press enter to select the object.

3. To anchor the perimeter value on the work area, click or press enter.



The measurements in the example are the perimeters of the circle and polygon.

The measurement remains visible and close to the object even if you change the size of the object. If you alter an object, the measurement updates to reflect the new perimeter value.

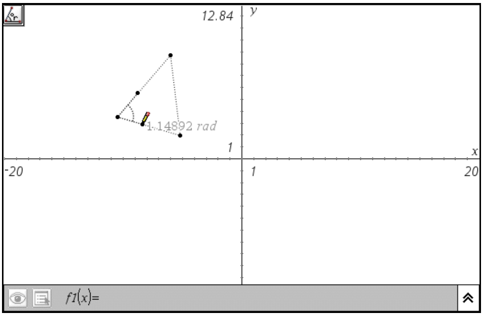
Finding the measure of an angle

1. From the Measurement menu, select the Angle tool ( ).

   Press menu 7 4.

2. If the angle you want to measure exists on this space, click once on one side of the angle.
3. Click on the vertex.
4. Click once on the second side of the angle.

   The measure of the angle you defined appears near it.



5. Click or press enter to anchor the value on the work area.

Defining an angle with three points

You can define and measure an angle by selecting three points on the work area.

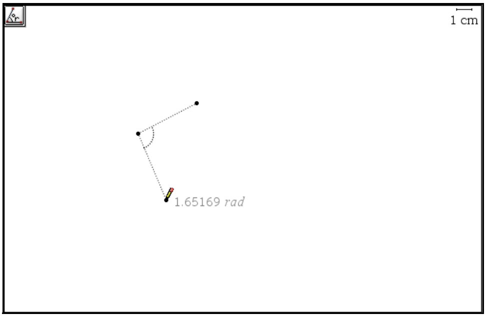
1. From the Measurement menu, select the Angle tool ( ).

   Press menu 7 4.
2. Click once on the work area.

   The first click represents one side of the angle.
3. Click a second time on the work area.

   The second click represents the vertex.
4. Click a third time on the work area.

   The third click represents the second side of the angle. The measure of this angle appears on the work area.



5. Click or press enter to anchor the value.

The measurement remains visible and close to the angle even if you change the size of the angle. If you alter the angle, the measurement updates to reflect the new value.

Notes:

- The value of any angle will always be between 0° and 180° in degree mode or between 0° and π in radian mode.
- The default angle measure is in radians. To change it to degrees or gradians, change the document settings.
- You can increase the precision of the angle measurement by placing the pointer on top of the measurement and then pressing + or - to increase or decrease the value.

Repositioning a measured value

1. Select the Pointer tool ( ).

   Press menu 1 1.

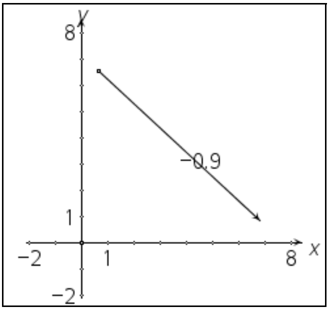
2. Select and drag the measurement to the desired location.

Finding the slope of a line, ray, segment or vector

1. From the Measurement menu, select the Slope tool ( ).

   Press menu 7 3.

2. On the work area, click or press enter to select the object.
3. Click or press enter to anchor the value on the work area.



The slope remains visible and close to the object even if you alter the slope. Note that the value changes as the object is moved.

Note: If the object is vertical, the slope value is -∞ or +∞. If the object is horizontal, the slope value is 0.

Adding text to the work area

You may want to add your own text to a page or enter a numerical value to use on the work space. Graphs & Geometry enables you to do this using the Text tool (AbI).

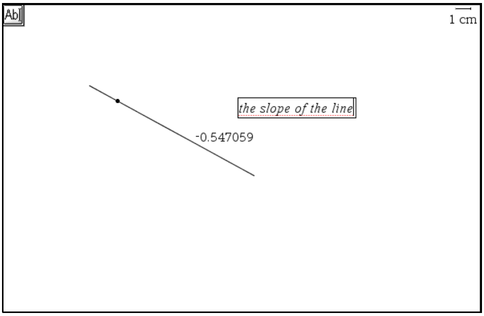
1. From the Tools menu, select the Text tool (AbI).

   Press menu 1 5.

2. On the work area, select the location to add text, and click.

   A blinking cursor appears at the spot you selected.

3. Type your text.



   You are limited to typing the text that will display on the page.

If you use the Text tool ( ) to enter numerical values, these are interpreted as numbers by Graphs & Geometry and can be used for computing or specifying measurements.

4. Click again or press enter to anchor the text on the work area.

To exit this mode, select another tool or save your work.

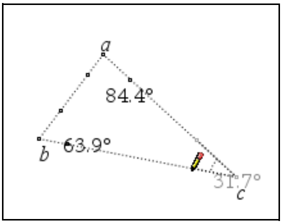
Moving text

1. Select the text with the Pointer tool ( ).
2. Drag it to the new location.
3. Click the text to anchor it in the new position.

Using the Calculate tool

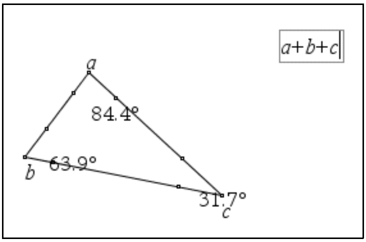
The Calculate tool ( ) enables you to perform arithmetic calculations using measured and entered values. An example best shows how this tool is used.

1. Create an object and display measurements for it. In this example, a triangle is constructed and its angles are measured.



2. Use the Text tool ( ) to write the desired formula. Here, the angle measurements are added.

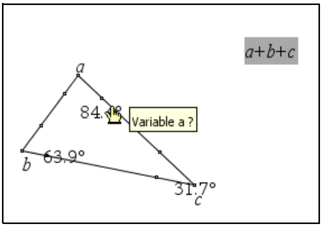
   Press menu 1 5.

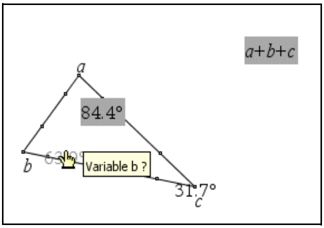


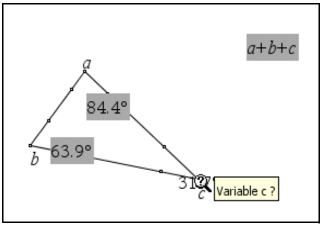
3. Select the Calculate tool ( ).

Press menu 1 7.

Select the formula just created, then select each angle measurement.

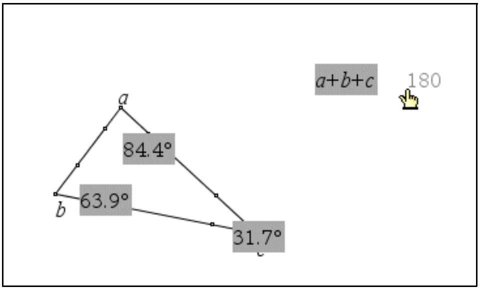






4. When all variables in the formula have values, the answer displays on the work area.

5. Click to anchor the value.



Exploring functions, graphs and objects

Once you create graphs and objects, you can use other tools to explore various relationships among and between them.

Finding points of interest: zeroes, minima, maxima

When you create a graph, you can use the Point On tool () (press menu 6 2) to locate the zeros, minima, and maxima if these are possible to display on the work area. (They may not be displayed if their location on the graph is on a part not visible on your screen.) Both local and global points of interest display. To find them, just move the point along the object or graphed line, and when you are near a point of interest, the coordinates display along with one of the following identifiers:

- Zeroes: z (Coordinates)
- Minimum: m (Coordinates)
- Maximum: M (Coordinates)

Finding the min and max of a function

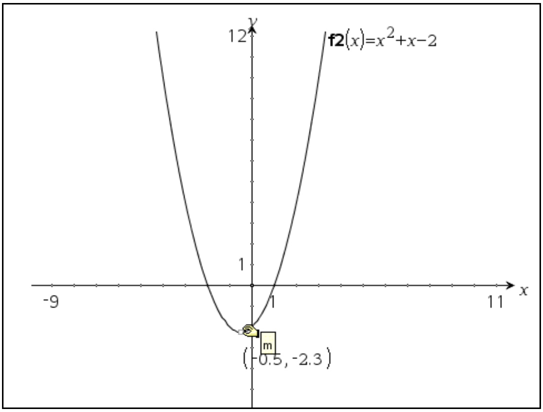
To find the minimum or maximum of a function or object on the graph:

1. From the Points & Lines menu, select the Point On tool ().

   Press menu 6 2.
2. Select the function graph or object.
3. From the Tools menu, select the Pointer tool ().

   Press menu 1 1.
4. Select the point created in Step 2 and drag it along the function graph or object.

   As you approach a point of interest, the one-character identifier along with the point's coordinates display. The example below shows the m (minimum) identifier along with the value of the minimum for the function graphed on the axes.



5. As you move away from the point of interest, the identifier no longer displays on the page.

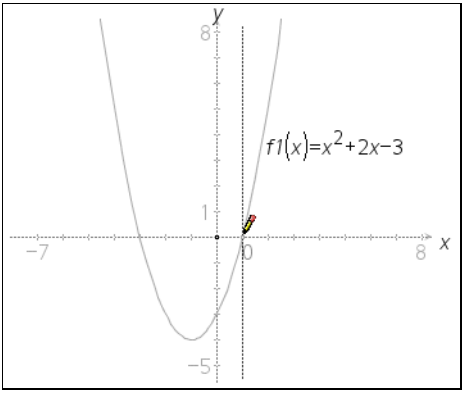
Finding the definite integral of a function

1. Select the function.

2. From the Measurement menu, select the Integral tool ().

   Press menu 7 5.

3. Define the range for the integral, both the upper and lower limit. Do this by clicking on the function to display a limit boundary line.

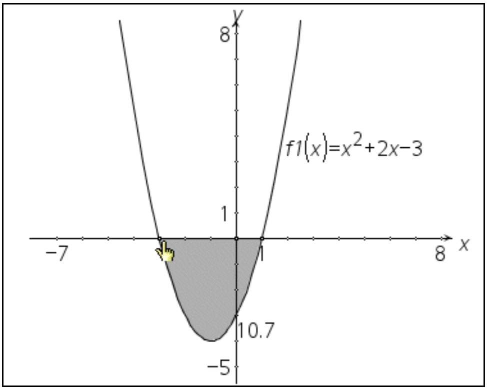


4. When the boundary line is in the desired location, click to anchor it on the page.

5. Move the cursor to display the second limit boundary line.

6. When it is correctly located on the page, click to anchor it.

Notice that the integral between the bounds and with respect to the x-axis is shaded on the page.



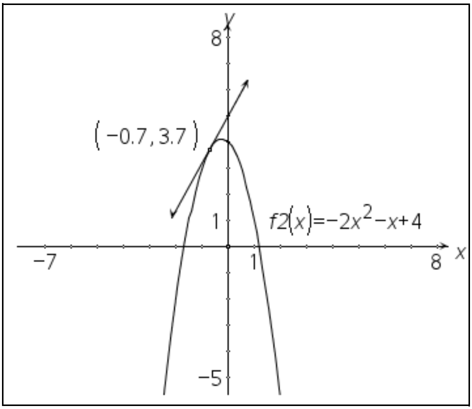
Tips:

- To stop the boundary line at a tic mark on the *x*-axis, select the tic mark.
- For precise integral boundaries, type a numerical value instead of graphically placing either or both lower and upper boundary lines.

Finding the derivative of a function at a point (the slope)

1. Graph a function.
2. Select a point on the graph.
3. From the Points & Lines menu, select the Tangent tool ().

   Press menu 6 7.
4. Construct the tangent at this point.



Tangent line created for the function. The point of tangency is labeled.

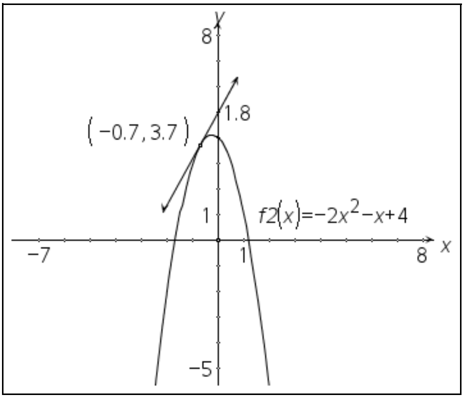
5. From the Measurement menu, select the Slope tool (![]).

   Press (menu) 〈7〉 〈3〉.

6. Determine the slope at the tangent.

   This is the value of the derived function for the selected value of x.

7. Click to anchor the value on the page.



Transformations

You can apply transformations to drawn objects, and some can be applied to functions. When working with functions, the axes are most frequently involved and may be required. Object transformations can occur without the use of axes as a reference point.

The transformations supported by Graphs & Geometry are:

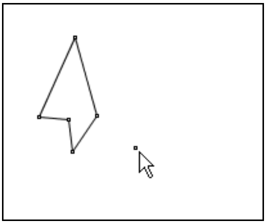
- Symmetry with respect to any point, including the origin
- Reflections with respect to any straight line, including the axes
- Translations along any vector, including vectors on the axes
- Rotations about any point, including the origin, and any angle
- Dilations from any point, including the origin, with any factor

The first step in any transformation is to create an object or the graph of a function.

Exploring symmetry

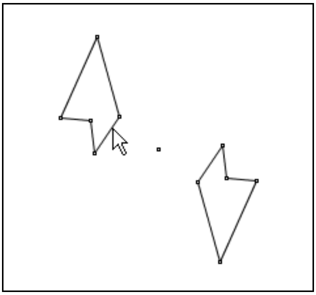
1. Create an object or graph a function.
2. Create a point of symmetry using the Point tool ( ).

   Press menu 6 1.



3. From the Transformation menu, select the Symmetry tool ( ).

   Press menu A 1.
4. Select the object, then select the point.
5. The symmetrical image displays.



Exploring reflection

1. Create an object.

2. Create a line or segment about which the object will be reflected.

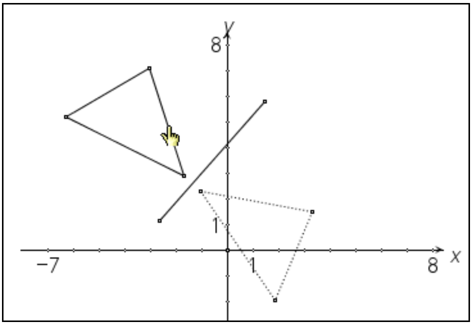
3. From the Transformation menu, select the Reflection tool ().

   Press (menu) (A) (2).

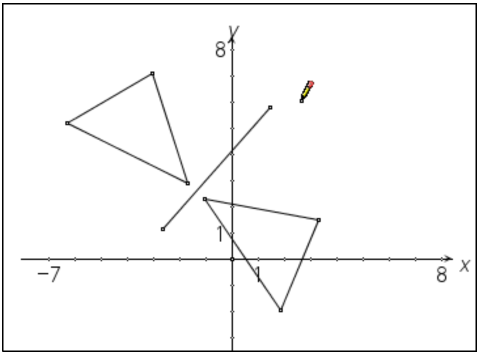
4. On the work area, select the reflection line or segment.

5. Select the object.

   The object reflection displays on the page.



6. To anchor the reflection, double click on the page or press (enter).



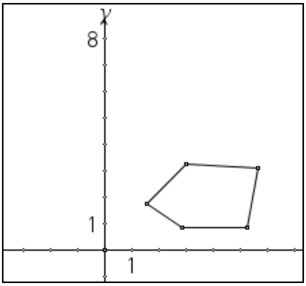
Exploring translation

1. Create an object to translate (duplicate).

2. You can define the distance and direction of translation by

   - creating a vector, or
   - selecting two points "on the fly".

   To use a vector, define it before performing the translation. The examples use two points to define translation distance and direction.



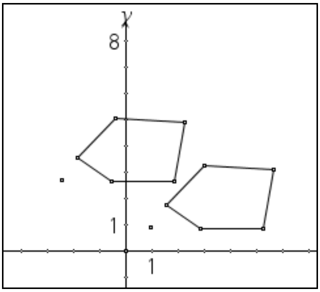
3. From the Transformation menu, select the Translate tool ( ).

   Press menu A 3.

4. Select:

   - the vector or click twice on the page to define the translation direction and distance
   - translation object.

   The translated object displays.

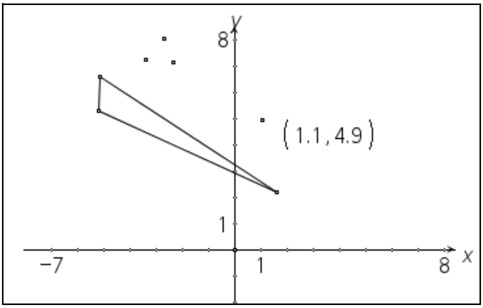


Exploring rotation

1. Create an object or graph a function.
2. Create a point about which the object will be rotated.
3. Create three points whose angle defines the angle of rotation, or using the Text tool ( ), type a numeric angle value.

   Press menu 1 5.

4. Press enter to anchor the value on the work area.



Triangle ready for rotation. The rotation point is labeled with coordinates. The three angle of rotation points appear above the triangle.

5. From the Transformation menu, select the Rotation tool ().

   Press menu A 4.

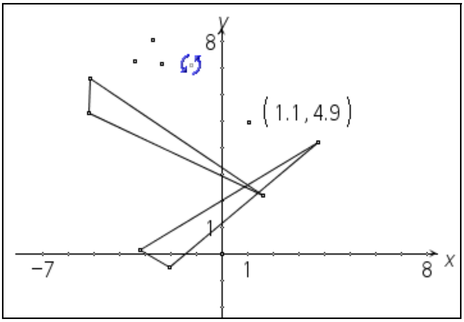
6. Move to the work area and select

   a) the point about which the object will be rotated, and

   b) the object to rotate, and

   c) the three points that define the angle of rotation or the numeric angle value.

   The object is recreated in the rotated position as defined by the rotation point and angle of rotation.

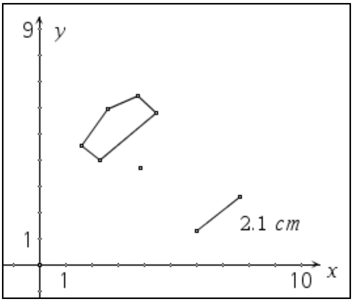


Exploring dilation

1. Create an object.
2. Create a point that is the center of the dilation.
3. Create a number using the Text tool ()or measure an existing length.

Press menu 1 5 and press enter to anchor the value on the work area.

Note: If you type a large number, the dilated object will not display on the work area without panning.



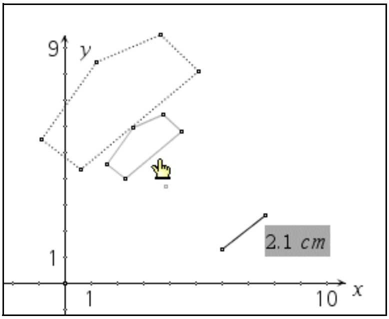
Polygon, dilation point, and measurement on page.

4. From the Transformation menu, select the Dilation tool ( ).

   Press menu A 5.

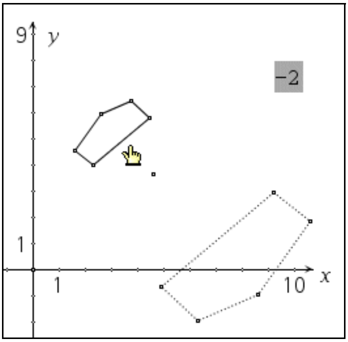
5. Select the value measured or created, the dilation point, and then move toward the object.

   The dilation appears on the work area.



In the following example, the polygon from the previous example was retained, but a negative number was entered using the Text tool ( ).

Press menu 1 5.



Other investigations

You can investigate graphs by

- Bisecting segments
- Bisecting angles
- Finding the Locus

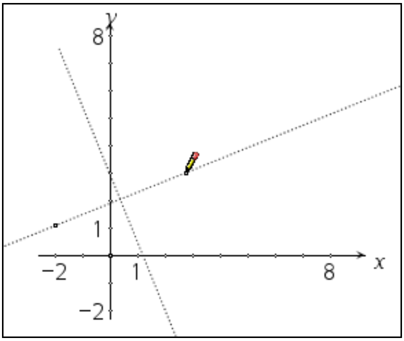
Bisecting a segment defined on a line

1. From the Construction menu, select the Perpendicular Bisector tool ( ).

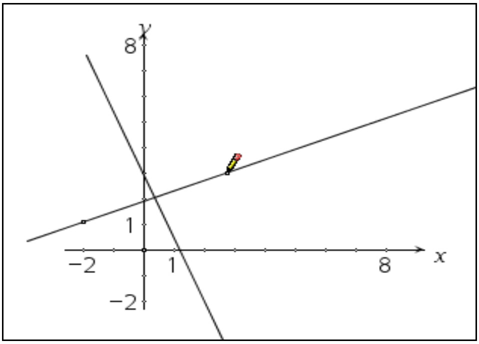
   Press menu 9 3.

2. Click on the line to select one end point for this segment.
3. Move to another point on the line and select it.

   The segment is now defined, and the perpendicular bisector is drawn.



Creating the second point on a line.



Perpendicular bisector anchored on
segment between two defined points.

Bisecting a segment

1. From the Construction menu, select the Perpendicular Bisector tool ().

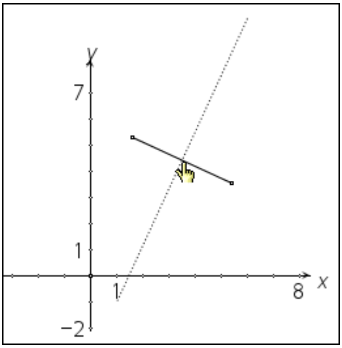
   Press menu 9 3.

2. Click the segment.

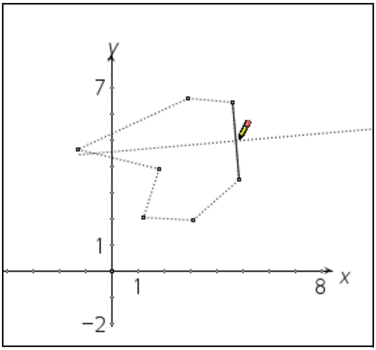
   The perpendicular bisector displays.

3. Click once more to anchor the bisector on the work area.

   Note: A segment can be one side of a triangle, rectangle, or a polygon.



Bisecting an existing segment (bisector not anchored on page).



Bisecting the side of a polygon (bisector not anchored on page.)

Bisecting an implied segment

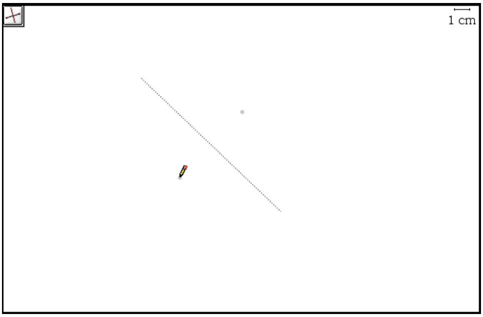
1. From the Construction menu, select the Perpendicular Bisector tool ( ).

   Press (menu) 9 3.

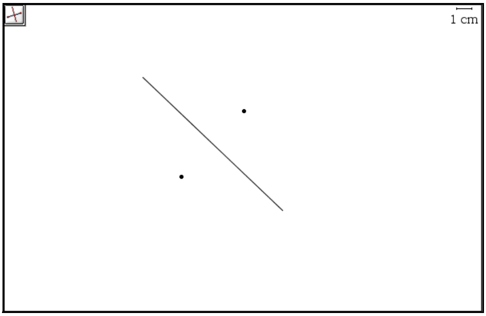
   You imply a segment by defining two points.

2. Click once to define one end of the implied segment.

   As you move away from this point, a segment and the bisector appear.



3. Click a second time to define the other end of the implied segment and anchor the segment and bisector.



Bisecting an angle

1. From the Construction menu, select the Angle Bisector tool ().

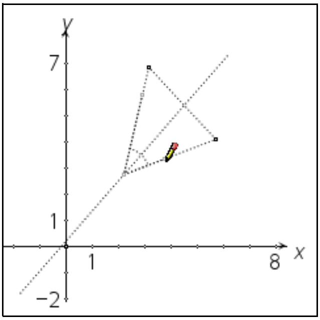
   Press menu 9 4.

2. If a triangle or other angle already exists on the work area, click once on one side of the desired angle.

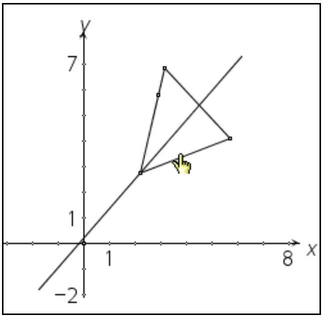
3. Click once on the vertex.

4. Click once on the second side of the angle.

   The bisector is anchored on the work area.



Creating the angle bisector at the vertex of a triangle.



Anchoring the angle bisector on the page.

Bisecting an implied angle

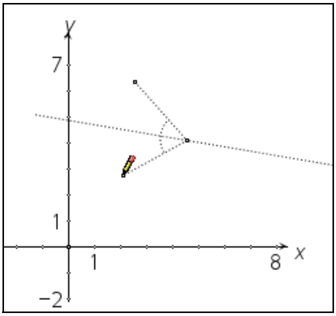
1. From the Construction menu, select the Angle Bisector tool ( ).

   Press menu 9 4.

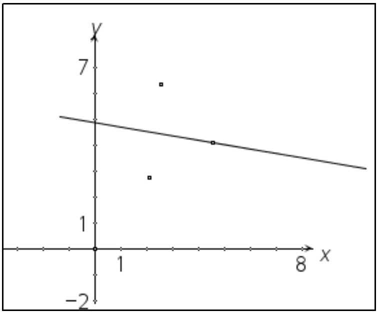
   If no angle is present on the work area, you can create one by selecting three different points.

2. Click to define the first side of the angle.
3. Click to define the vertex of the angle.
4. Click to define the second side of the angle.

   The bisector line appears and is anchored on the work area when you select the third point.



Creating an angle bisector by defining three points. The second point represents the vertex of the angle.



Angle bisector created by defining three points on the page.

Note: If you select the Pointer tool () and move one point of the created angle, the angle bisector moves so that it always bisects the angle.

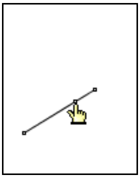
Press menu 1 1.

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.

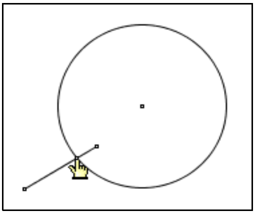
To create a locus:

1. Create a segment, line, or circle.
2. Create a point on the segment, line or circle.



Point defined on the line segment.

3. Create another object that uses the defined point created in the previous step.



Circle created to use the defined point on the segment.

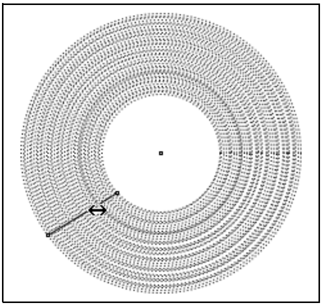
4. From the Construction menu, select the Locus tool ( ).

   Press menu 9 6.

5. On the work area, select the last object.

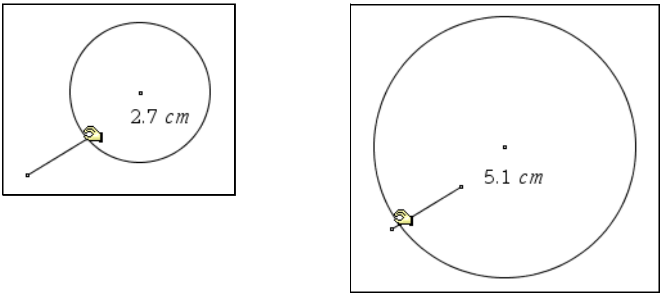
6. Select the defined point used by both objects.

   The continuous locus picture is displayed.



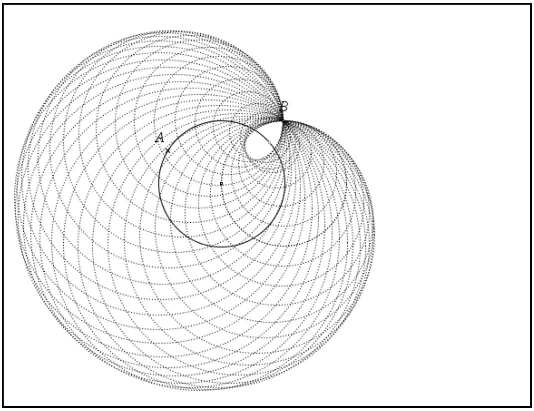
7. Move the point on the first construction.

   The second construction deforms to follow the locus point.

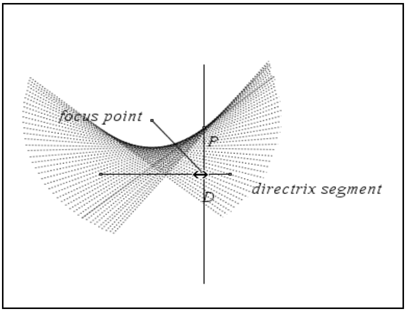


Two examples of the radius change of the circle as the locus moves along the line segment. The radius is labeled to better show the change.

You can create and explore a large number of designs using the Locus tool and your imagination. The following are examples of a few structures that you can create.



Locus created from two overlapping circles.



Locus created using a point and a segment.

Animating objects

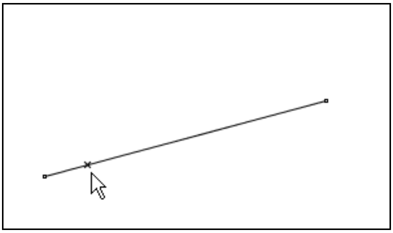
You can animate a point on a line, ray, axis, vector, graph, segment or circle. In addition, you can also animate points on multiple objects in the work area at one time.

Animating one point on an object

1. From the Points & Lines menu, select the Point On tool ( ).

   Press menu 6 2.

   Click on the object to identify the point that you want to animate.



2. From the Tools menu, select the Attributes tool ( ).

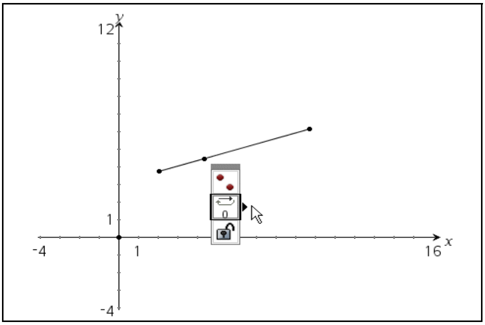
   Press menu 1 3.

   When the attribute bar displays, select the animation attribute ( ).

3. The default speed is 0. You can type a number from 1 - 9 to set speed or you can use < or > to select a speed from -12 to 12.

   The higher the number you type, the faster the animation speed.

4. Select → for one-way animation or ↔ for oscillating animation.



5. Animation begins automatically when you select the speed and direction.

   Press + and − to increase/decrease the speed of animation incrementally once it is set.

The animation control panel

Once a point is animated, a floating control panel displays on the page. You can move this panel by dragging it to a new location.

When animation is active, the panel contains a Reset and a Pause button. When either button is pressed and animation is reset or paused, the Pause button changes to a Start button. These controls affect all animated points on a page.

Panel when animation is active

Panel with animation paused/reset

Changing the animation of a point in motion

To change the speed of a point's movement or the direction of animation:

1. Reset or pause the animation.

   a) Select the Attributes tool ( ).

   b) Select the point you want to change.

   c) When the attribute bar displays, select the animation attribute ( ).

2. To change the speed, type a new velocity number.
3. To change the direction of animation, press to select the desired direction.
4. Press the Start button.

   The point moves at the new speed and/or in the new direction you selected.

Pausing and resuming animation

To pause the animation on a page, select the Pause button.

To restart animation, select the Start button.

Resetting animation

Selecting the Reset button not only pauses animation but also returns the animated point to its initial coordinate position on the object when animation was first started. If multiple points are animated on the page, all are returned to their original locations when you select Reset.

Stopping animation

To stop the animation of an object:

1. Select the Pause or Reset button on the control bar.
2. Display the Animation tool for the point.
3. Change the speed to 0 (zero).
4. Click an empty area of the screen to apply the change, or press .

5. Select Start ▶ to resume animation if other animated points were temporarily stopped.

   If no other animated points are on the page, the animation control box does not reappear when the velocity is set to 0.

   Note: If you have multiple points in motion on one page and want to permanently stop the animation of all objects, when motion is paused or stopped, display the attributes bar for each point and change the velocity to 0.

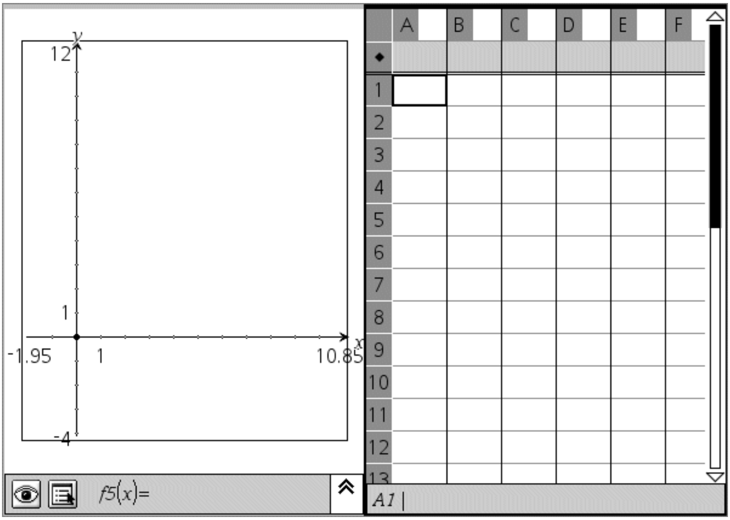
Working with plots

In addition to using Graphs & Geometry by itself, you can use it to explore the data collected from scientific instruments or stored in lists. Graphs & Geometry can take the data and create plots that are more helpful in understanding and interpreting data than just examining the raw values.

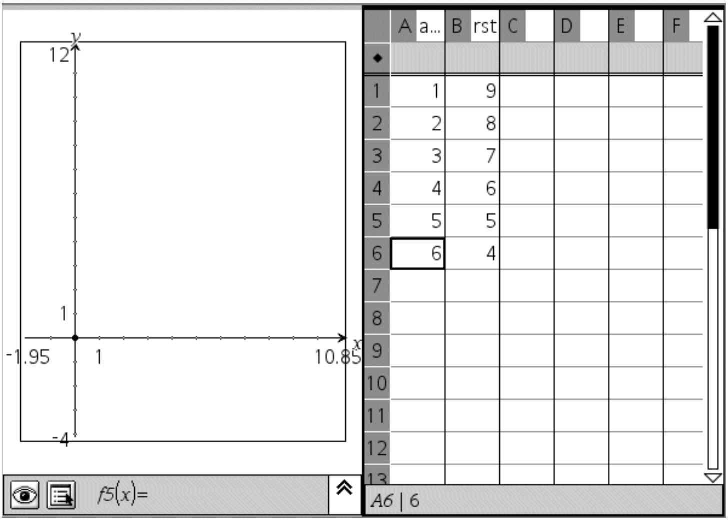
Creating a scatter plot

If you do not have an existing set of data points available for plotting, create them on the same page using the Lists & Spreadsheet application.

1. To create the data lists and scatter plot on the same page, select a page configuration with two work areas.

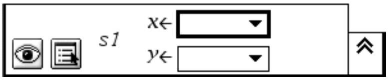


2. Create the data lists on the Lists & Spreadsheet portion of the page.

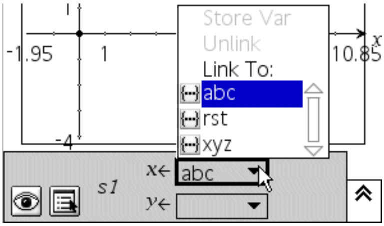


3. Select the Scatter Plot tool ( ) .

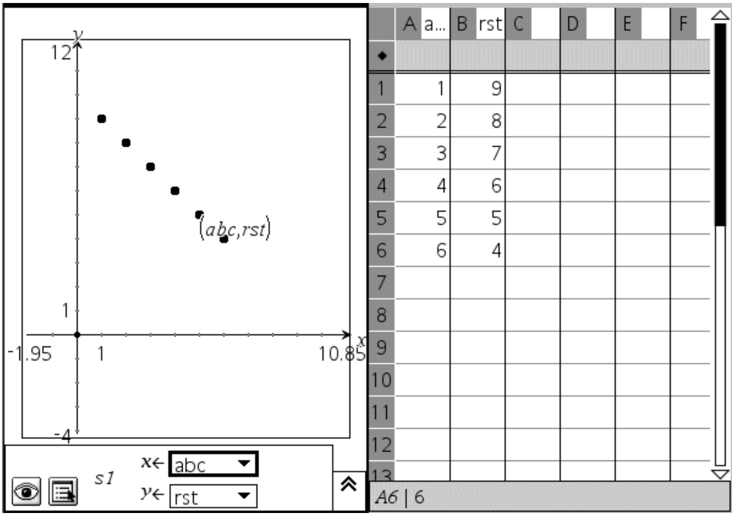
Press menu 3 3.



4. Select the lists to plot from the drop down list for each axis.



When both entry fields have a data list specified, the scatter plot displays on the Graphs & Geometry work area.



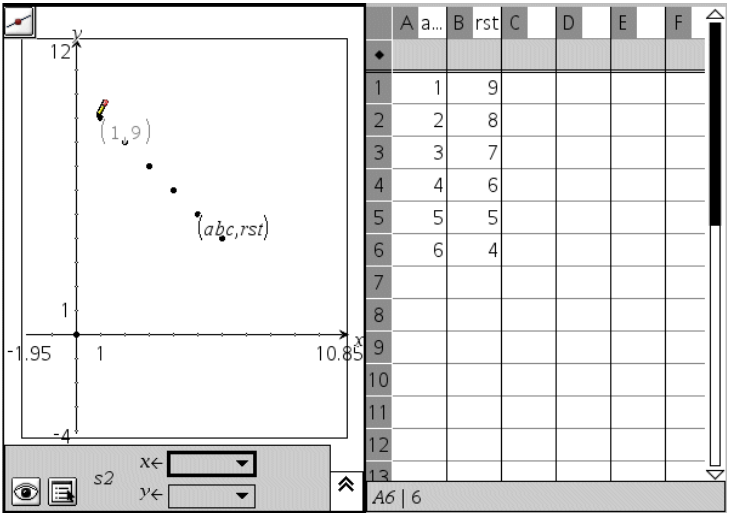
5. To label the points on the scatter plot, select the Point On tool ( ) from the Points & Lines menu.

   Press (menu) 6 2.

   a) Select the first point.

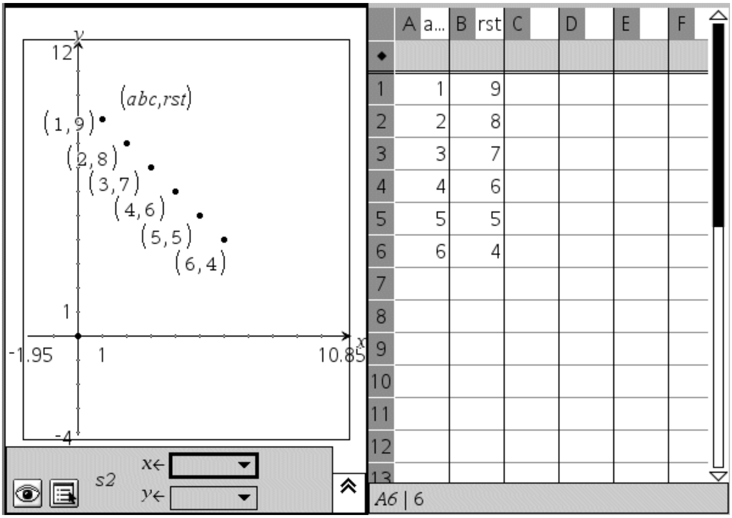
      The coordinates display.

   b) Click to anchor the values on the work area.



c) To label the remaining points, select them one at a time.

Click each one to anchor the coordinates on the work area.



6. Label the axes and significant points, if desired.

Note: If you have plotted more than one set of data, notice that each plot has a different point style.

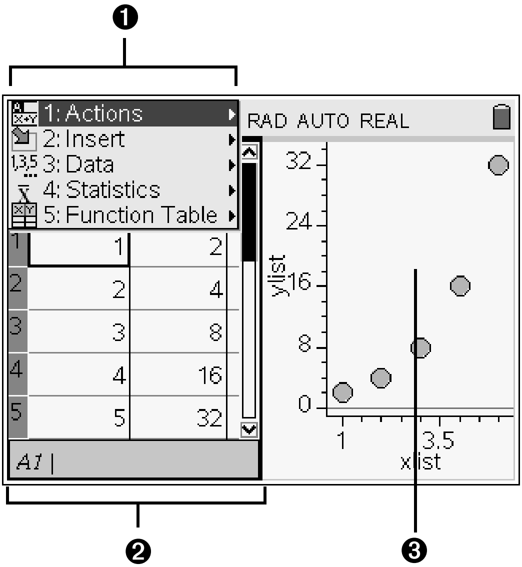
You can use Graphs & Geometry to examine the differences between points in one data set or between two or more sets by determining the slope between points, comparing min and max points, and/or calculating overall change over elapsed time.

Using Lists & Spreadsheet

Getting started with tables

The Lists & Spreadsheet application gives you a place to work with tablular data. You can use Lists & Spreadsheet to:

- Store numeric data, text, or math expressions.
- Define a table cell in terms of the contents of other cells.
- Define an entire column in terms of another column.
- Work with variables created in the Graphs & Geometry and Calculator applications.
- Collect tables of real-world data from sensors.
- Generate columns of data based on other columns or sequences that you define.
- Share individual cells with other TI-Nspire™ math and science learning technology applications as variables, and share columns of data as lists.
- Plot table data using the Data & Statistics application.
- Generate function tables from functions defined in Calculator or Graphs & Geometry.
- Perform statistical analysis on lists of data.



❶ Lists & Spreadsheet menu (available when a Lists & Spreadsheet work area is active) Press (menu) to display the menu.

❷ Sample Lists & Spreadsheet work area

❸ Lists & Spreadsheet data shared with another TI-Nspire™ application

The Lists & Spreadsheet tool menu

The Lists & Spreadsheet tool menu lets you modify your display and enter and evaluate a variety of math expressions.

Menu Name	Menu Option	Function
Actions		
	Move Column	Lets you reposition the current column.
	Resize	Lets you stretch or shrink rows and columns.
	Select	Selects an entire row or column, or helps you insert a range of cells into a cell formula.

Menu Name	Menu Option	Function
	Go To (ctrl G)	Jumps to the specified cell, such as **d16** or **g20**.
	Recalculate (ctrl R)	Recalculates results of all cell formulas.
	Sort	Lets you sort the selected columns of the spreadsheet based on the contents of a single column.
Insert		
	Insert Cell	Inserts a cell.
	Insert Row	Inserts a row above the current row.
	Insert Column	Inserts a column before the current column.
Data		
	Generate Sequence	Displays a dialog box for creating a sequence.
	Data Capture	Allows manual or automatic capture of object data from Graphs & Geometry. Use ctrl . to trigger each manual capture.
	Fill Down	Lets you duplicate the contents of a selected cell or group of cells within a column.
	Quick Graph	Uses the Data & Statistics application to graph one or two selected columns of data as a dot plot or scatter plot.
Statistics		

Menu Name	Menu Option	Function
	Stat Calculations	Lets you select from several statistics calculations, such as one-variable analysis, two-variable analysis, and regressions.
	Distributions	Lets you select from several distributions, such as **Normal Pdf**, **Binomial Cdf**, and **Inverse F**.
	Confidence Intervals	Lets you select from several confidence intervals, such as **t interval** and **z interval**.
	Stat Tests	Lets you select from several hypothesis tests such as **t test**, **z test**, and **ANOVA**.
Function Table		
	Switch to Function Table (ctrl T)	Toggles the function table view.
	Select Function	Lets you select a different function for the current column.
	Edit Function Table Settings	Lets you change the viewing parameters for the table.
	Delete Column	Removes the current column.
	Edit Function Expression	Lets you change a function definition without leaving the function table.

Before you begin

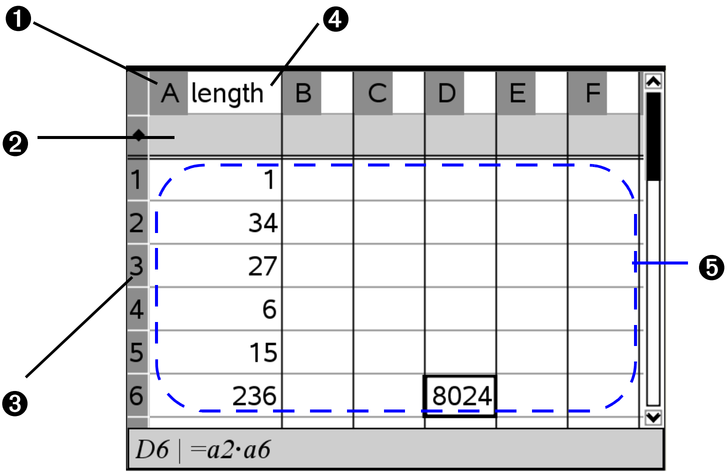
- Turn on the TI-Nspire™ handheld, and add a Lists & Spreadsheet application to a document.

Navigating in a table

You can select any cell to view or edit its contents. When a table is larger than the Lists & Spreadsheet work area, you can view different parts of the table by:

- Pressing ◀, ▶, ▲, and ▼ to move through the table. This moves the selection from cell to cell and scrolls the table as necessary to keep the selected cell in view.
- Using 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).

A column letter appears at the top of each column, and a row number appears in the left cell of each row. The top two rows and the left column of the table remain in place as you scroll so you can more easily determine your location in the table.



❶ Column reference

❷ Header or formula row

❸ Row reference

❹ Column/list name

❺ Cells

Methods of entering table data

The method you use to enter table data depends on the type of data and your personal preferences. You can use different methods in combination.

- For numbers, text, and simple math expressions and formulas such as =a3•**length**^{2}, press the corresponding keys on the handheld keypad. In this example, press = A 3 × L E N G T H x^2.

- For more complex math expressions such as $\sum_{n=1}^{5} \frac{1}{n}$ press [catalog] to display the complete Catalog of system functions and commands, symbols, and expression templates.
- To display only the list of templates, press [ctrl] [templates].
- To display only the list of symbols, press [ctrl] [catalog].

Entering a math expression, text, or table formula

1. Select the cell in which you want to enter data.
2. Use the handheld keypad, the Lists & Spreadsheet tool menu, or the catalog to enter the data.
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.

   Lists & Spreadsheet automatically recalculates any cells in the table that are dependent on the cell you entered. If you have shared the cell, and other TI-Nspire™ math and science learning technology applications are linked to the cell, the other applications are also updated.

For details on entering math expressions, refer to the Calculator section.

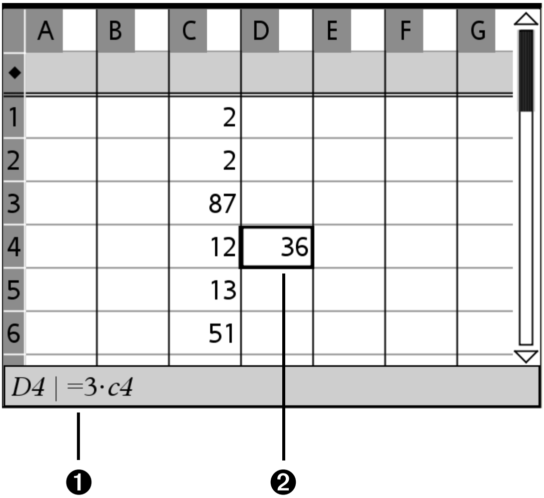
Working with individual table cells

Creating absolute and relative cell references

Cell references let you enter formulas that refer to table data instead of having to duplicate it and remember to update it. When you change the contents of a referenced cell, all references to the data are updated automatically in the table.

Anytime you want to update all references and formula results in the table, you can select **Recalculate** from the **Actions** menu (or press [ctrl] [R]).

Cell formulas begin with the = symbol. You refer to a cell by using its column letter and row number. Entering =3*C4 as a formula, for example, creates an expression that is 3 * the contents of the cell at column **C**, row **4**.

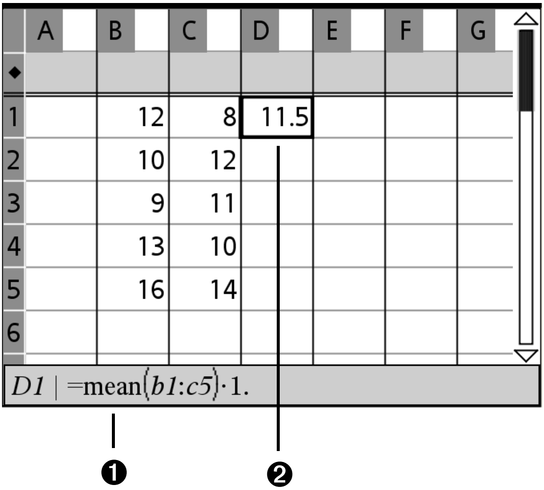


❶ Formula containing a cell reference entered in cell D4

❷ Result of formula (3*12=36)

You can refer to a rectangular block of cells in a formula by entering the location of the upper-left cell and the lower-right cell, separated by a colon.

For example, `=mean(B1:C5)*1.` creates a result that is the mean of all cells in the block bounded by columns **B** through **C** and rows **1** through **5**. (The "*1." in the expression forces the result to a decimal approximation.)



❶ Formula that refers to a rectangular block of cells

❷ Result of formula

References such as `C4` and `C4:E11` are *relative* references. Lists & Spreadsheet keeps track of relative cell references. It adjusts each reference automatically when you copy or move the cell containing the reference to another location in the table.

If you need a reference that always refers to a cell in a specific location in the table, use an *absolute* reference. To create an absolute cell reference, type a $ symbol before the column letter and row number. The $ symbol is available in the Symbol Palette (ctrl ∞β°).

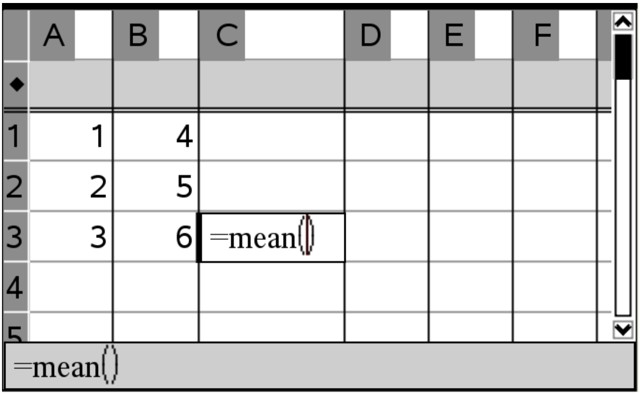
For example, type C4 to create an absolute reference to the cell in column C, row 4. Lists & Spreadsheet does not adjust absolute references in a formula when you copy or move the cell containing the reference.

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.

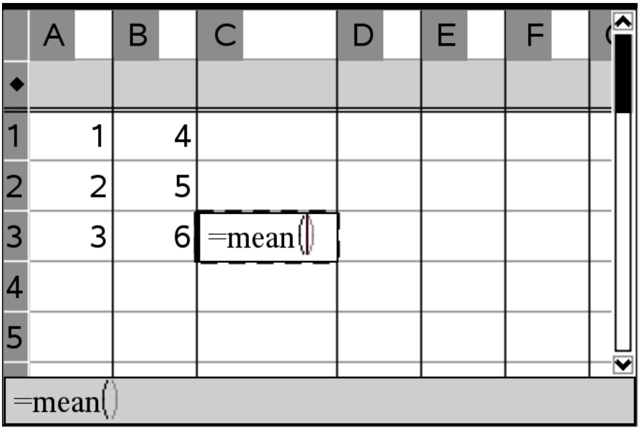
Suppose you want to calculate the mean of a range of cells.

1. Type "`=mean(`" in the cell that will contain the result.



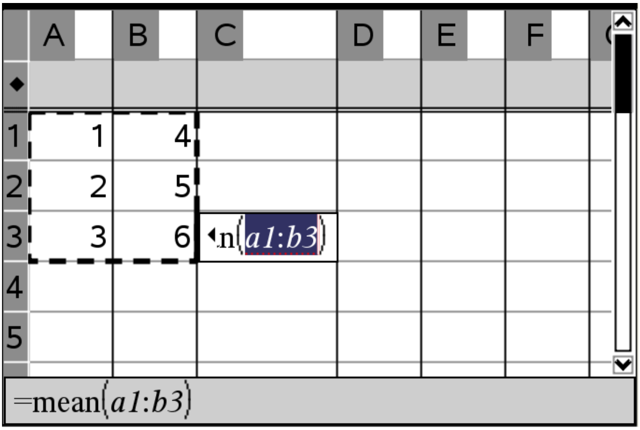
2. Press menu to display the Lists & Spreadsheet menu.
3. On the **Actions** menu, choose **Select**, and then choose **Select Range**.

   A dotted selection rectangle appears around the cell.

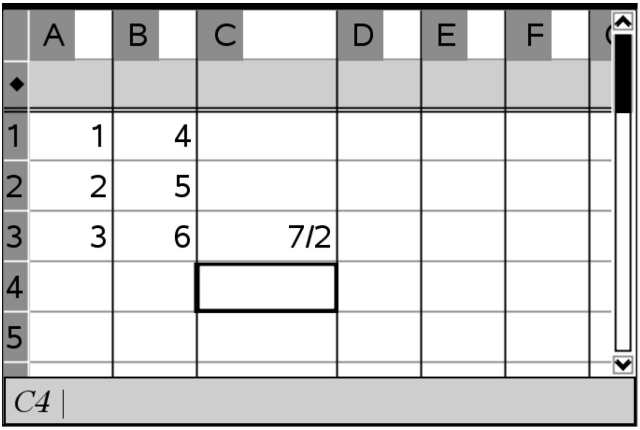


4. Use the arrow keys along with the **Shift** key (CAPS ⇧) to select the range of values whose mean you want to calculate.

   The formula is updated as you select.



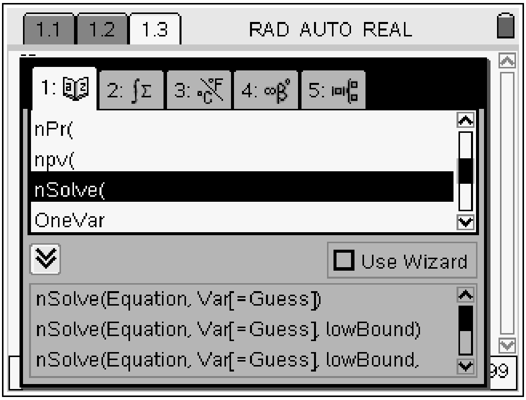
5. Press enter to complete the formula, and press enter again to evaluate the formula and display the result.



Inserting items from the Catalog

You can use the Catalog to insert system functions and commands, symbols, and expression templates into a cell formula.

1. Select the cell and type "=" to begin the formula.
2. Press to open the Catalog.



Note: Some functions have a wizard that prompts you for each argument. If you prefer to enter the argument values directly in the cell, you may need to disable the wizard.

3. Press the number key for the category of the item. For example, press 1 to show the alphabetic list.

 shows an alphabetic list of functions and commands.

shows math functions and commands by category.

shows a table of symbols.

shows expression templates.

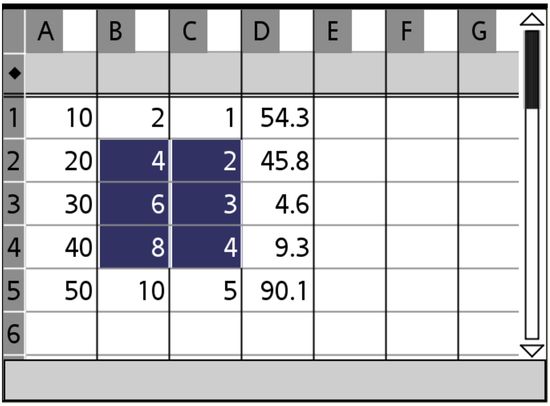
4. Press ▼ and then use ◄, ►, ▲, or ▼ as necessary to select the item that you want to insert.

   Note: To see syntax examples of the selected item, press [tab], and then press [enter] to alternately show or hide the Help. To move back to the selected item, press [caps] [tab].

5. Press [enter] to insert the item into the entry line.

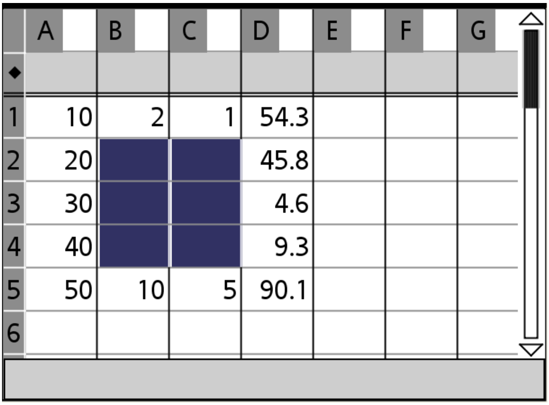
Deleting the contents of a cell or block of cells

1. Press ◄, ►, ▲, or ▼ to select the cell. (You can also hold down the [caps] key and then press ◄, ►, ▲, or ▼ to select a rectangular block of cells.)



2. Press [clear].

   The selected cell contents are deleted.

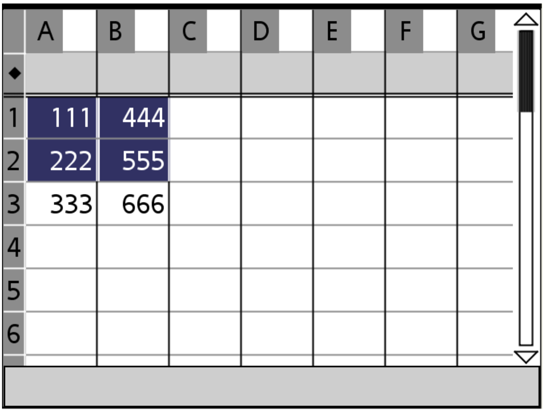


Note: If other cells contain formulas that refer to the cell's previous contents, those cells show an error.

Copying a cell or block of cells

When you copy cells, the formulas (if any) in the original cells are copied to the destination cells, replacing the previous contents of those cells.

1. Press ◀, ▶, ▲, or ▼ to select the cell. (You can also hold down the CAPS ⇧ key and then press ◀, ▶, ▲, or ▼ to select a rectangular block of cells.)

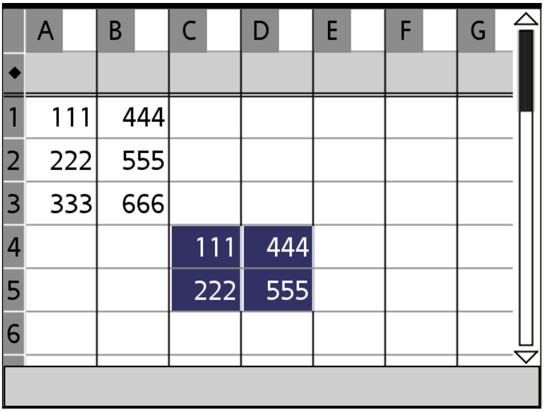


2. Press ctrl C.

   The selected cell contents are copied to the Clipboard.

3. Select the cell where you want to duplicate the copied cell. If you are copying a block of data, select the cell that will become the upper left corner of the copied block.

4. Press ctrl V.



Filling adjacent cells

You can repeat a cell's formula or value throughout adjacent cells. This gives you a quick way to fill cells with the same value or create a series of cells that contain the same formula. You can fill down within a column.

1. Select the cell whose value or formula you want to repeat.
2. Press menu to display the Lists & Spreadsheet menu.
3. On the **Data** menu, select **Fill Down**.
4. Press ▼ repeatedly to move down, selecting the range of cells that will hold the repetitions.
5. Press enter.

   The selected cell is duplicated throughout the selected range.

Notes

- In step 1, you can select more than one cell to be repeated. If you do, make sure that you select enough destination cells to hold the repeated copies.
- If you select multiple cells in step 1 and the cells contain a simple sequence (such as 1,2,3 or 5,10,15,20), the sequence is continued in the filled area.

Sharing a cell value as a variable

You can share a cell value with other TI-Nspire™ applications. When you define or refer to a shared cell in Lists & Spreadsheet, the name is preceded with an apostrophe (‘).

1. Select the cell that you want to share.
2. Press ctrl sto▸ var (or press sto▸ var and select **Store Var**).

   A formula is inserted into the cell with *var* as a placeholder for a variable name.

3. Replace the letters “*var*” with a name for the variable, and press enter.

   The value is now available as a variable to other TI-Nspire™ math and science learning technology applications.

Note: If a variable with the name you specified already exists in the current problem, Lists & Spreadsheet displays an error message.

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.

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*).

1. Select the cell that you want to link to the variable.
2. Press sto▸ var.

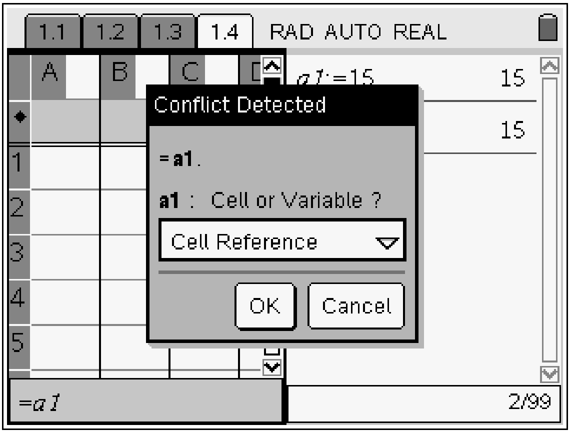
   The VarLink menu displays.

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.

Preventing name conflicts

A TI-Nspire™ shared variable can have the same name as a table cell or column letter. To help prevent name conflicts in your table formulas, Lists & Spreadsheet asks for clarification when you enter a name that could conflict.



You can also use the following syntax rules.

- To refer to a variable whose name could conflict with the name of a cell (such as A1), precede the variable name with an apostrophe (‘A1).
- To refer to a table column (such as A) without conflicting with a single-letter variable name *A*, follow the column letter with a pair of brackets (A[]). To enter the brackets, press ctrl [] and then press ▶.

To refer to:	Use this syntax:	Remarks
The shared variable *A1*.	‘A1	The apostrophe avoids a possible conflict with table cell A1.
The table cell at column A, row 1.	A[1]	This syntax always refers to a table cell, avoiding a possible conflict with variable *A1*.
Column A of the current table.	A[]	Brackets avoid a possible conflict with variable *A*.
The shared variable *myvar*.	myvar	No special syntax needed, because this name does not conflict with a cell or column reference.

Note: In certain examples, Lists & Spreadsheet may not display the Conflict Detected dialog box to notify you of a possible variable-name conflict. Also, the dialog box may appear even when you have used the apostrophe or brackets to prevent a conflict.

Working with rows and columns of data

Selecting a row or column

▶ Move to the top of the column, and then press ▲.
– or –
Move to the leftmost cell of the row, and then press ◀.

Resizing a row or column

1. Select the row or column that you want to resize.
2. Press (menu) to display the Lists & Spreadsheet menu.
3. On the **Actions** menu, select **Resize**.
4. Use ◀ and ▶ to resize the column, or use ▲ and ▼ to resize the row.
5. Press (enter).

Inserting an empty row or column

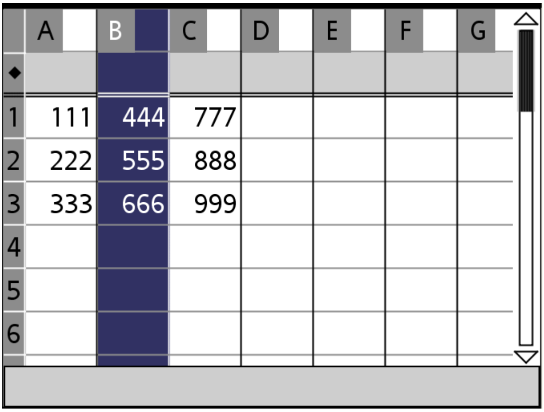
1. Select the column or row where you want to insert the new data.
2. Press (menu) to display the Lists & Spreadsheet menu.
3. On the **Insert** menu, select either **Row** or **Column**.
   – If you are inserting a row, the remaining rows shift down to create space for the new row.
   – If you are inserting 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.

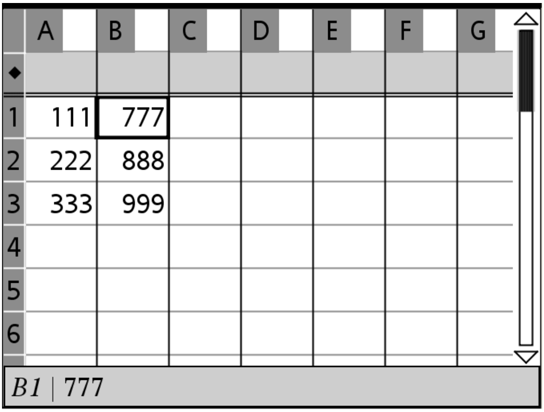
1. Select the column or row that you want to delete.



2. If you are deleting more than one row or column, hold down ⇧ (CAPS), and press ◀ and ▶ to select additional columns or press ▲ and ▼ to select additional rows.

3. Press ⬅ (clear).

   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. Select the column or row that you want to copy.

2. If you are copying more than one row or column’ press shift, and then press ▲, ▼, ◀, or ▶ to select an additional item.

3. Press ctrl C to copy the selected items.

   The selected rows or columns are copied to the Clipboard.

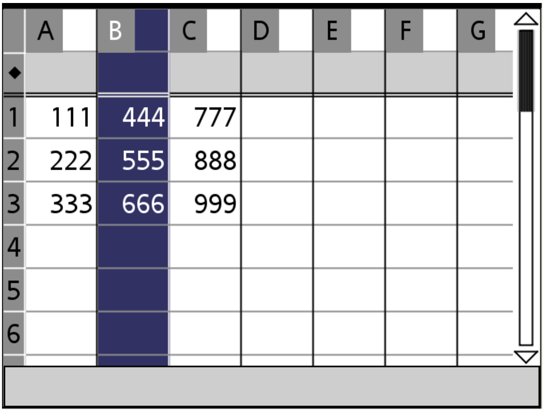
4. Move to any cell in the row or column where you want to insert the copied item.

5. Press ctrl V to paste the selection.

   The copied row or column is pasted in place, replacing the previous contents.

Moving a column

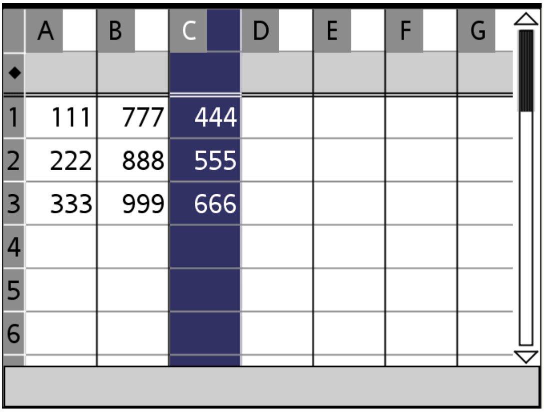
1. Select the column that you want to move.



2. Press menu to display the Lists & Spreadsheet menu.

3. On the **Actions** menu, select **Move Column**. An insertion bar appears.

4. Press ◀ or ▶ to place the insertion bar at the column’s new position, and then press enter.



Note: Relative references to any cell whose position is affected by the move adjust accordingly.

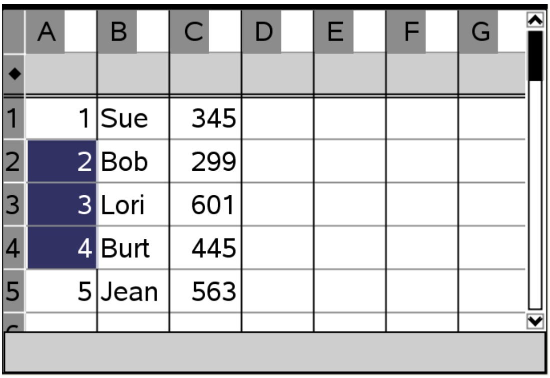
Sorting data

You can sort a selected area of the table 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.

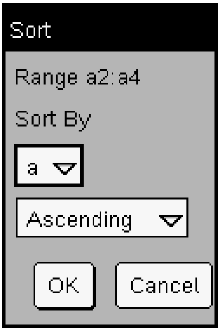
Sorting a range of cells in a column

1. Select the range of cells.

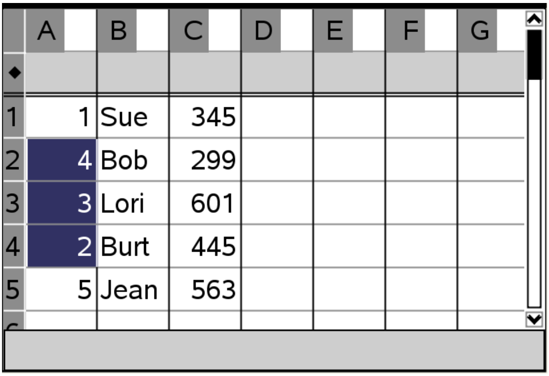


2. Press (menu) to display the Lists & Spreadsheet menu.

3. On the **Actions** menu, select **Sort**.

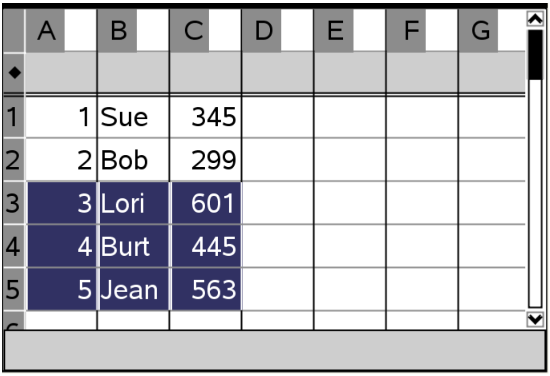


4. Select **Descending** as the sort method for this example, and then select **OK**.

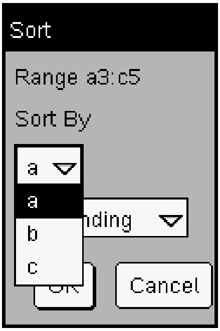


Sorting a rectangular region

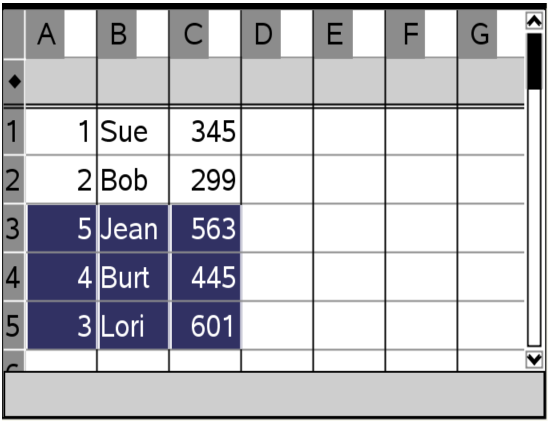
1. Select the region of cells.



2. Press (menu) to display the Lists & Spreadsheet menu.
3. On the **Actions** menu, select **Sort** to display the Sort dialog box.
4. Select column **a** as the column on which the sort will be based for this example. You can select from columns within the selected region only.

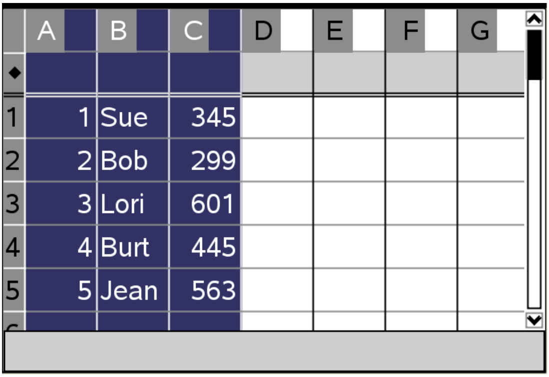


5. Select **Descending** as the sort method for this example, and then select **OK**.

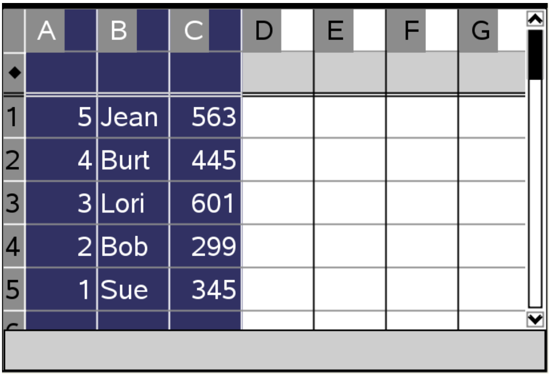


Sorting entire columns

1. Select the range of columns to sort.



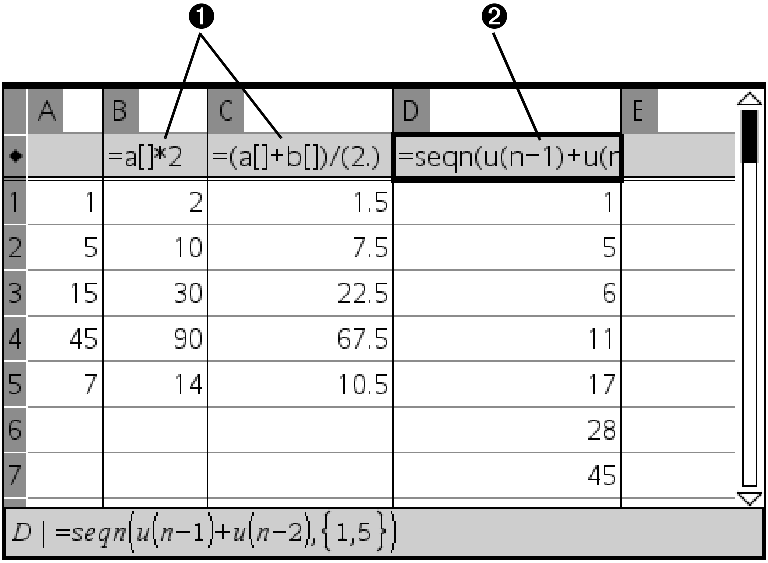
2. Press (menu) to display the Lists & Spreadsheet menu.
3. On the **Actions** menu, select **Sort**.
4. Select column **a** as the column on which the sort will be based for this example.
5. Select **Descending** as the sort method for this example, and then select **OK**.



Generating columns of data

You can create a column of values based on another column. You can also create a column based on any of several types of sequential data.

Entering a formula in the header row of the column tells the Lists & Spreadsheet application that you want to apply the formula to all the cells in the column, not just to a single cell.



❶ Column formulas based on other columns

❷ Column formula that generates a sequence

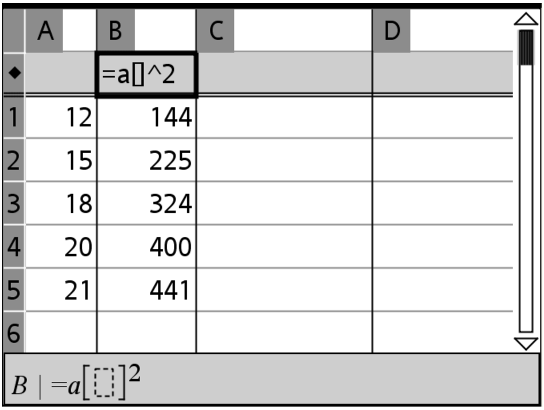
Notes

- 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. Select the header cell (second cell from the top) of the column where you want to enter a column formula.
2. Type = followed by the expression, and then press enter. Use brackets ([]) after any column letter you include in the formula. For example, type `=A[]^2` (press = A ctrl [ ] ▸ ^ 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 header cell and fills the column with the results.

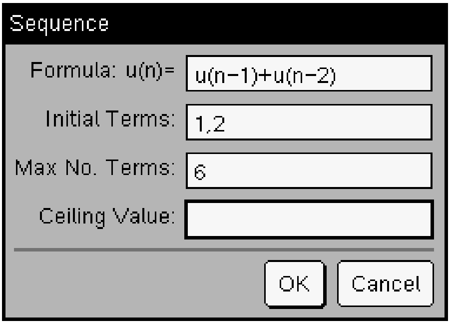


Generating a numerical sequence

1. Select any cell in the column in which you want to generate the sequence.
2. Press menu to display the Lists & Spreadsheet menu.
3. On the **Data** menu, select **Generate Sequence**.

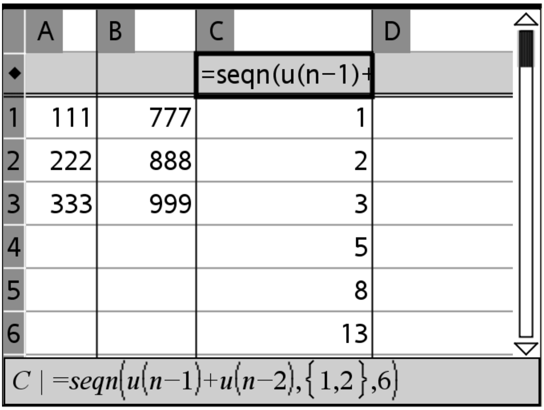
   Lists & Spreadsheet displays a dialog for defining the sequence.

4. Type any starting numbers required by the sequence. **u0** is the first number in the sequence, **u1** is the second, and **u2** is the third.
5. Type a maximum value for the sequence, if you want to specify a maximum.
6. Type a maximum number of values to be generated, if you want to specify a maximum.
7. Type the formula that will be applied to the column values to generate the sequence.



8. Select **OK**.

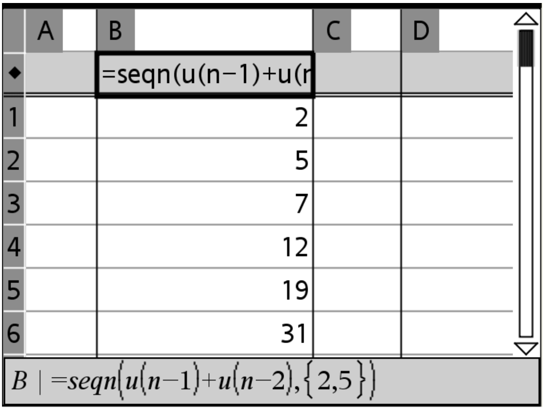
   Lists & Spreadsheet shows the formula in the header cell and fills the column with the results.



Note: If you prefer, you can enter a formula for the sequence directly into the header cell of the column.

For example, enter `=seqn(u(n-1)+u(n-2),{2,5},7,100)` to generate a Fibonacci series that uses 2 and 5 as the first two numbers. The sequence stops at a maximum value of 100 or a maximum of 7 values, whichever occurs first.

9. Type the formula in the header cell, and then press enter. For example, enter `=seqn(u(n-1)+u(n-2){2,5})` to use 2 and 5 as the first two numbers.



Creating and sharing table 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 Graphs & Geometry, Calculator, Data & Statistics, and other instances of Lists & Spreadsheet within the current problem.

Note: Lists & Spreadsheet can display a maximum of 2500 elements in a list.

Sharing a table column as a list variable

You share a column of data by naming it as a list variable.

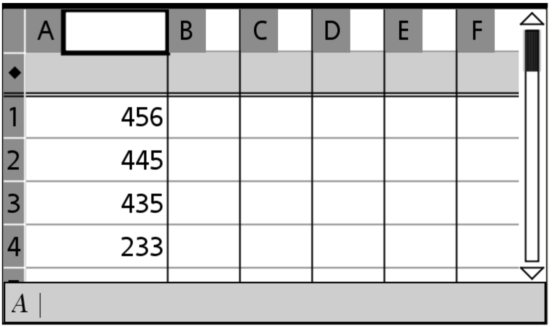
Note: Because column letters and variable names use a different syntax, you can refer to the shared list variable A in a formula without conflicting with column A[] of the current table.

Avoid defining variables that use the same names as those used for statistical analysis. In some cases, an error condition could occur.

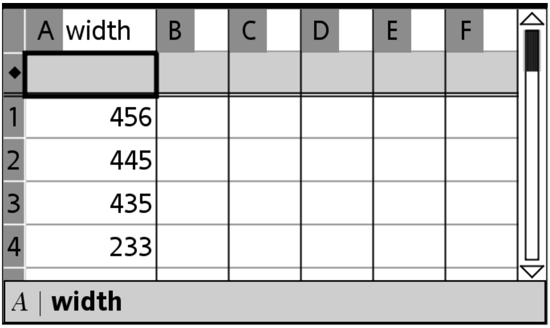
Variable names used for statistical analysis are listed in the Reference Guide, under the **stat.results** entry.

Method 1

1. Press ▲ as necessary to select the name cell (the white cell at the top) of the column that you want to share.



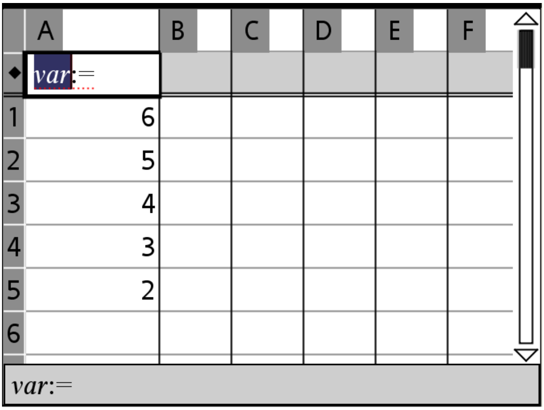
2. Type a name for the shared list. for example, type `width`.
3. Press enter.



Method 2

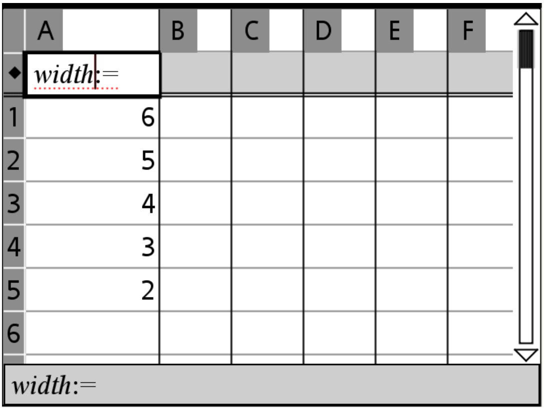
1. Press ▲ as necessary to select the header cell (the second cell from the top) of the column that you want to share.
2. Press sto► var, and select **Store Var**.

   An expression is inserted into the header cell with *var* as a placeholder for the list name.



3. Replace the letters “*var*” with a name for the shared list. For example, type **`width`**.

   The header cell now contains an expression similar to **`width:=`**.



4. Add the formula at the end of the expression. For example, **`width:=E[]*3`**.

5. Press enter.

   The column is now available as a list variable to other TI-Nspire™ applications.

Notes:

- If a variable with the name you specified already exists in the current problem, Lists & Spreadsheet displays an error message.

- Because a list cannot contain empty elements, any empty cells are automatically given a value of zero.

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.

Lists can contain empty elements. An empty element appears in Lists & Spreadsheet as a blank cell.

Linking to an existing list variable

Linking a Lists & Spreadsheet 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. Press ▲ as necessary to select the header cell (the second cell from the top) of the column that you want to link to the variable.
2. Press sto► var, and select **Store Var**.
3. Type = followed by an apostrophe and the name of the list.
   For example, type `='width`.

Note: 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*).

4. Press enter.

   The column shows the list elements.

Inserting an element in a list

When you insert an element in a list, the remaining elements shift downward to create space. For example, if you insert an element at position L1[2], the element that was previously L1[2] shifts down to become L1[3], and so on to the end of the list.

The downward shift affects only the column defined as a list. No other columns are affected.

1. Press menu to display the Lists & Spreadsheet menu.
2. On the **Insert** menu, select **Insert Cell**.

Deleting an element from a list

When you delete an element, the remaining list elements shift upward to close the gap. For Example, if you delete element L1[3], the element that was previously L1[4] shifts up to become L1[3], and so forth to the end of the list.

The upward shift affects only the selected column.

1. Select the cell that you want to delete.
2. Press ctrl menu to display the context menu.
3. Select **Delete Cell**.

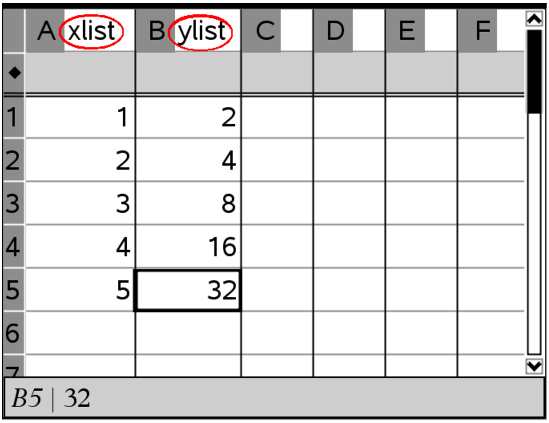
Note: If you press clear to clear the contents of the cell instead of deleting the list element, the element is assigned a value of 0 (zero). The remaining list elements do not shift.

Graphing table data

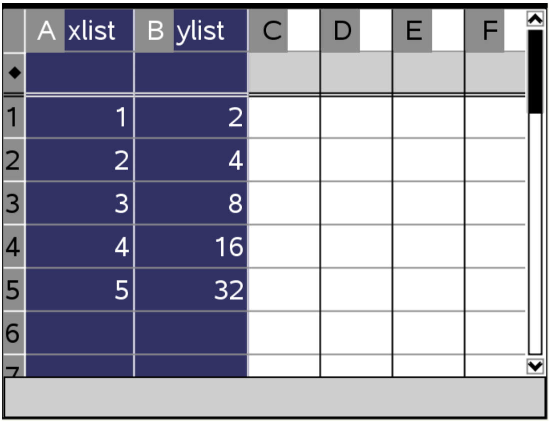
You can easily create a dot plot of the data in one column or a scatterplot of two adjacent columns by using the Quick Graph feature. This feature displays the graphed data using the Data & Statistics application.

To create a scatterplot:

1. Name both of the two columns to declare them as lists.

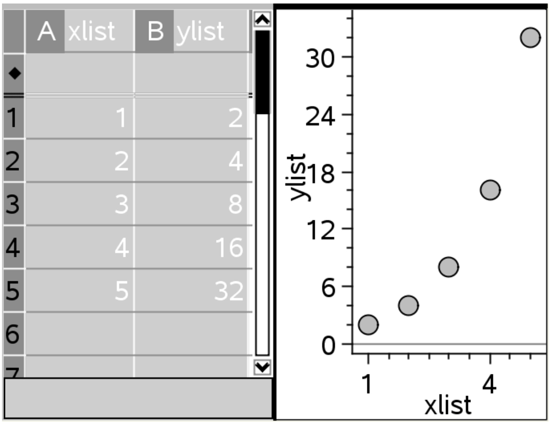


2. Select both columns.

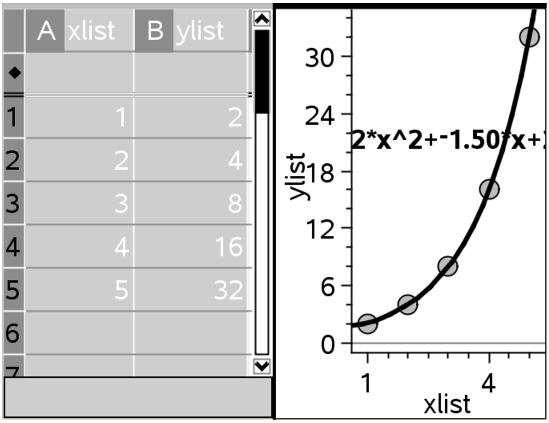


3. Press (menu) to display the Lists & Spreadsheet menu.
4. On the **Data** menu, select **Quick Graph**.

   A Data & Statistics window opens and shows the graphed data. The leftmost of the two lists is plotted on the x axis, and the other list is plotted on the y axis.



5. (Optional) Use the Data & Statistics features to analyze or visually enhance the graph.



Capturing data from Graphs & Geometry

You can use Lists & Spreadsheet to capture information about objects from Graphs & Geometry. For example, you might want to track changes in the area of a triangle as you change the length of a side.

You can select manual or automatic capture:

- With manual capture, you trigger the capture of each data element by pressing a specific key combination (ctrl .).
- With automatic capture, the capture of each data value is triggered automatically when you move or animate the target in Graphs & Geometry.

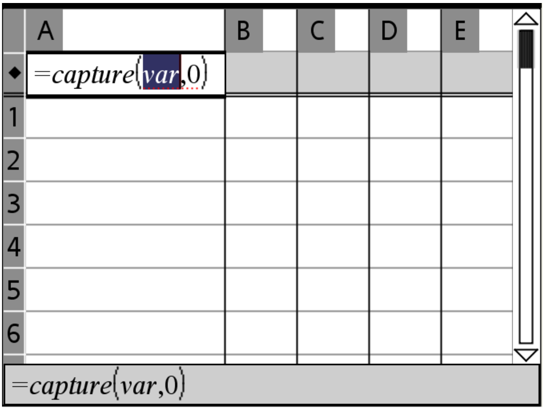
Capturing data manually

1. Select any cell in the column in which you want to capture the values.

   Note: Captured values will replace values in the column.

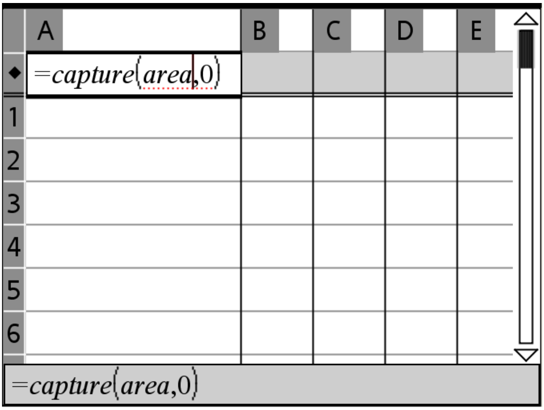
2. Press menu to display the Lists & Spreadsheet menu.
3. On the **Data** menu, select **Data Capture**, and then select **Manual Data Capture**.

   A capture expression is inserted into the header 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 header 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. Using Graphs & Geometry, change the object whose attribute (area in this example) you are capturing.

7. Each time you are ready to capture the current value of *area*, press ctrl ..

   The current *area* value is added to the end of the list as a list element.

Capturing data automatically

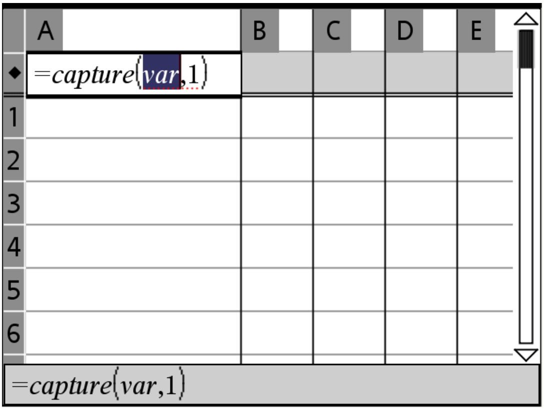
1. Select any cell in the column in which you want to capture the values.

   Note: Captured values will replace values in the column.

2. Press menu to display the Lists & Spreadsheet menu.

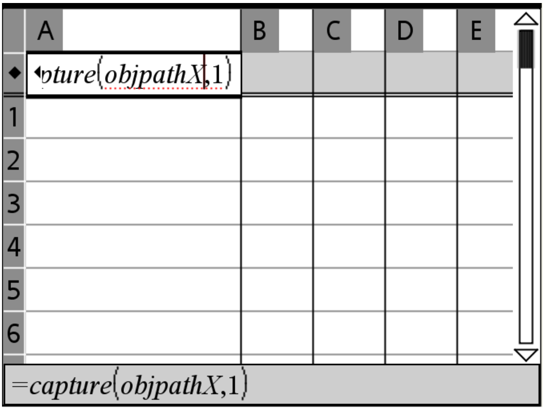
3. On the **Data** menu, select **Data Capture**, and then select **Automated Data Capture**.

   A capture expression is inserted into the header 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. For example, type `objpathX`. Alternatively, you can select the variable name from the VarLink menu.

   The header cell now contains an expression similar to `=capture('objpathX,1)`.



Note: The argument "**1**" tells Lists & Spreadsheet that you want to the captures to be triggered by Graphs & Geometry animation.

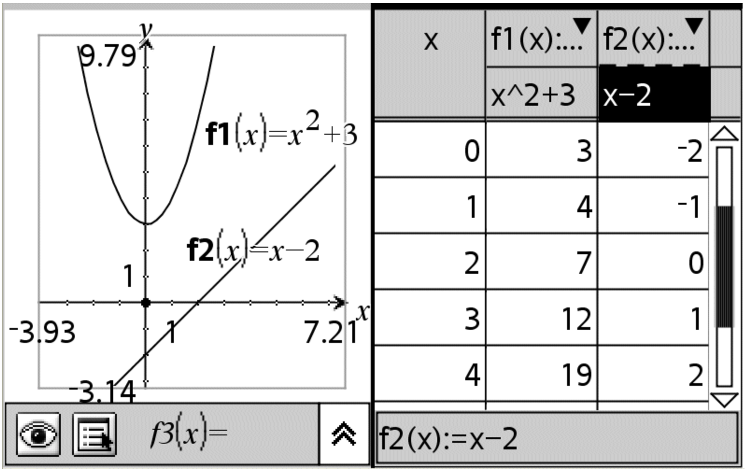
5. Press enter.

6. When you are ready to begin capturing the values of *objpathX*,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 in Lists & Spreadsheet as a list element.

Creating function tables

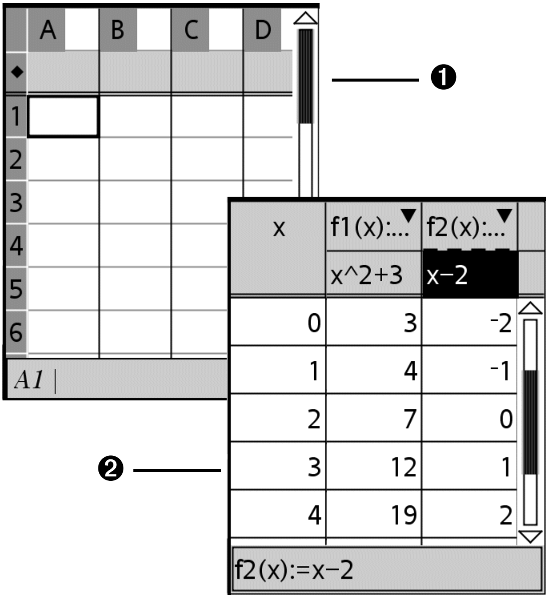
The Lists & Spreadsheet application lets you create a table of function values for any defined function in the current problem. You can set the parameters for the table and even edit a function definition without leaving Lists & Spreadsheet.



Showing and Hiding function tables

Anytime Lists & Spreadsheet is the active application, you can alternate between the standard Lists & Spreadsheet view and the function table view.

► Press ctrl T to toggle the view.



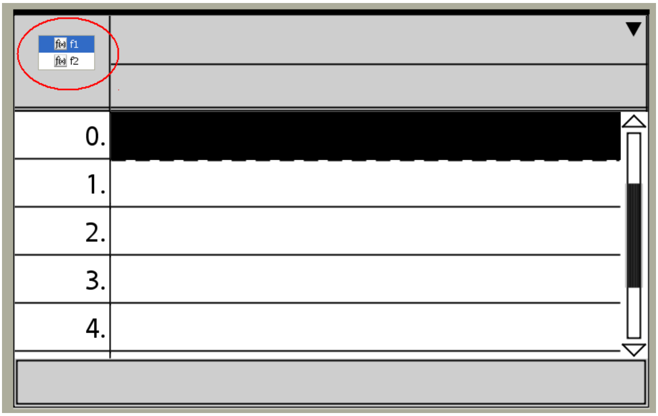
❶ Lists & Spreadsheet view

❷ Function table view

Generating a function table

1. Make sure you have defined at least one function.
2. In Lists & Spreadsheet, press ctrl T to toggle to the function table view.

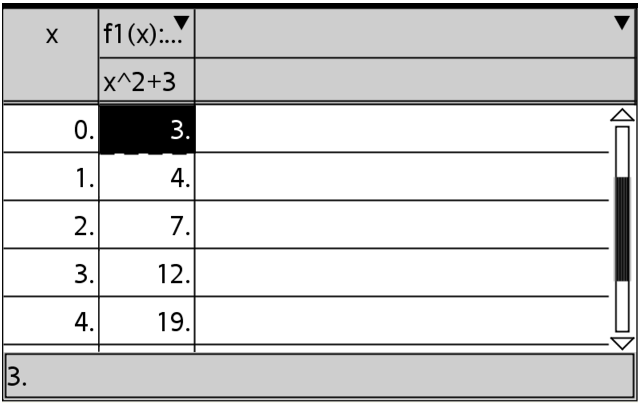
   The function table view appears with a small box listing available functions.



   Note: If a previous function is displayed, press ▶ to move to an empty column.

3. Select the function for which you want to create a table.

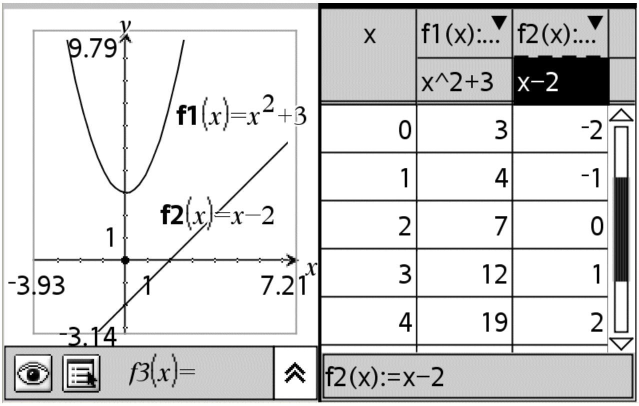
   By default, the table is generated using a start value of 0, a step value of 1, and the automatic setting for the independent and dependent variables.



Adding a function table from Graphs & Geometry

Adding a function table from Graphs & Geometry automatically creates an instance of Lists & Spreadsheet if none already exists on the current page. It also shows the function table view and automatically generates a table for the active Graphs & Geometry functions.

1. In Graphs & Geometry, select the functions for which you want to create a table.
2. Press (menu) to display the Graphs & Geometry menu.
3. On the **View** menu, select **Add Function Table**.



Viewing values in a function table

- Press ▲ or ▼ to view the values in the table.

As you move through the table, Lists & Spreadsheet generates the function values based on the independent variable (shown in the leftmost column). Scrolling upward from 0 displays negative values of the independent variable.

x	f2(x):...	f1(x):...
	x−2	x^2+3
⁻3.	⁻5.	12.
⁻2.	⁻4.	7.
⁻1.	⁻3.	4.
0.	⁻2.	3.
1.	⁻1.	4.
⁻3.		

Editing a function

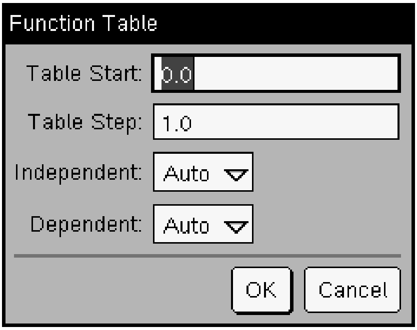
Besides using the other applications, such as Calculator and Graphs & Geometry, you can edit a function definition in the function table. Changes that you make are reflected in the other applications automatically.

1. Press tab as necessary to highlight the top area of the function tables, press enter, use ◀, ▶, ▲, and ▼ to highlight the function's expression, and then press enter.
2. A cursor appears in the expression.
3. Edit the expression, and then press enter.
4. The table for the function is updated, and the Graphs & Geometry graph of the function is also updated.

Changing the settings for a function table

Each function table uses initial settings that make it easy to scroll through values. If you prefer, you can set the Table Start and Table Step values manually, and you can choose to enter values manually for the independent and/or dependent variable.

1. Press menu to display the Graphs & Geometry menu.
2. On the **Function Table** menu, select **Edit Function Table Settings**.



3. Press tab to move among the settings, and either type a value or press ▲ or ▼ to change a setting.

   If you select **Ask** instead of **Auto** for a variable, you can enter a value manually when you select a cell.

Deleting a column in the function table

1. Press tab as necessary to highlight the top area of the function tables, press enter, use ◀ and ▶ to highlight the top cell of the column.
2. Press clear.

Using table data for statistical analysis

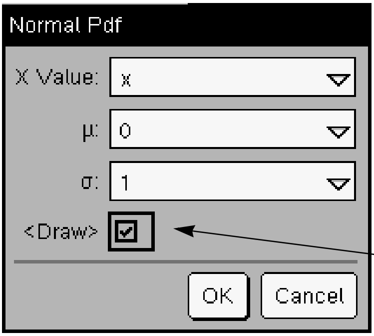
Lists & Spreadsheet uses wizards to help you perform statistical analyses on data in table columns. You specify the location of the data, and Lists & Spreadsheet stores the results in two columns: one for the result names, and one for the corresponding values.

You can access statistical analysis results as variables from other TI-Nspire™ applications by using the **Var** menu. The variables are stored in the form stat.*nnn*, where *nnn* is the result name (for example, stat.RegEqn and stat.Resid).

Plotting statistical data

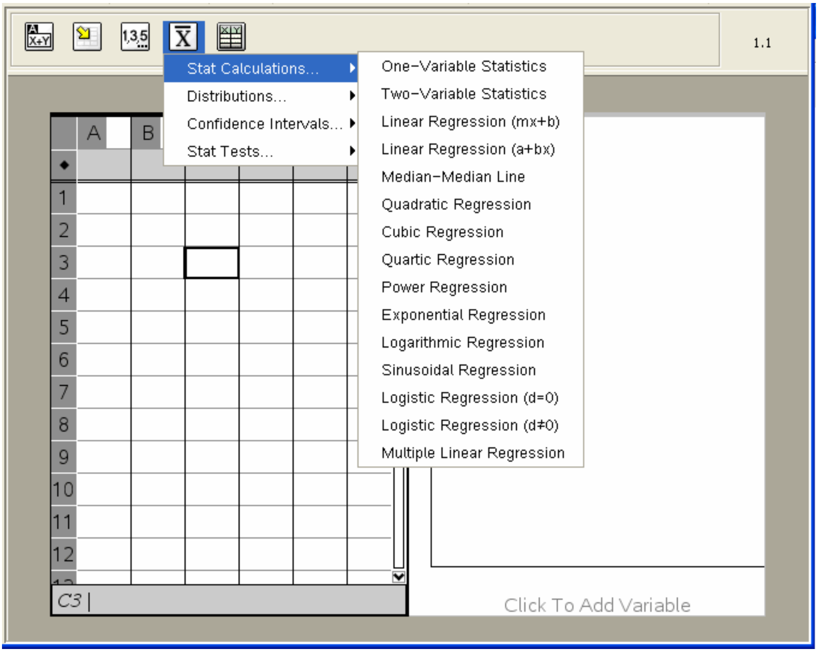
On some statistics wizards, there is a check box for Draw. By default, the box is not checked. Checking this box creates a Data & Statistics work area on the page, and displays the calculated results in Lists & Spreadsheet and draws the results of the statistical analysis in the Data & Statistics work area.

Note: The check box is displayed only if you select a header cell (second cell from the top) before beginning the analysis.



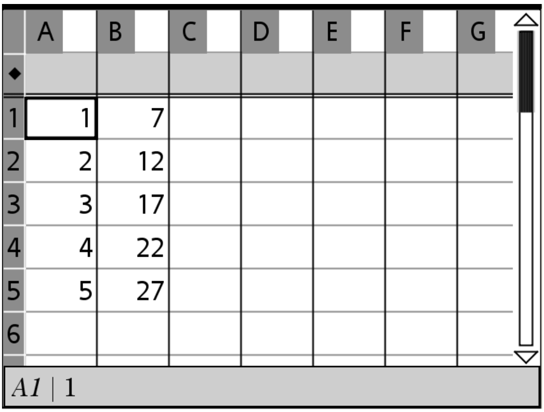
Draw check box in the Normal PDF wizard.

Statistical calculations



Performing a statistical calculation

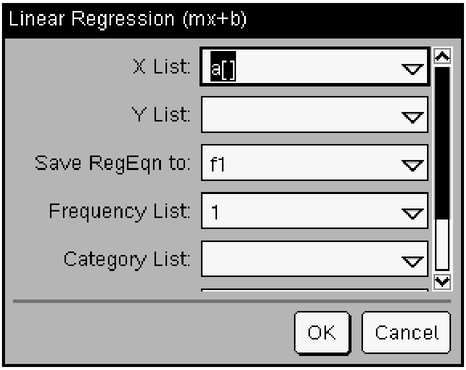
Suppose you want to fit a y=mx+b linear regression model to the following two lists:



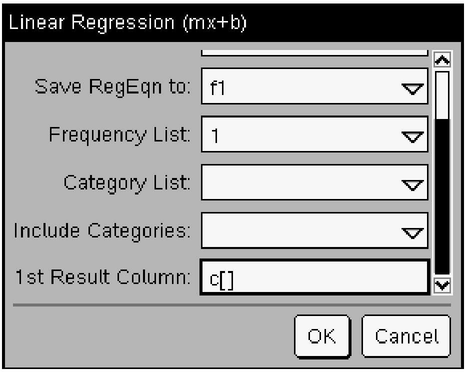
1. Select the header/formula cell (second cell from the top) in column A.

2. Press (menu) to display the Lists & Spreadsheet menu.
3. On the **Statistics** menu, select **Stat Calculation**, and select **Linear Regression (mx+b)** to choose the regression model.

   A wizard opens, giving you a labeled box to type each argument. Because you selected a cell in advance, the column for **X List** is already filled in.



4. Press (tab) to move to the **Y List** box.
5. Type `b[]` to specify the values in column B as **Y List**.
6. If you want to store the regression equation in a specified variable, press (tab), and then replace **Save RegEqn To** with the name of the variable.
7. Press (tab) as necessary to move to the **1st Result** box.
8. Type `c[]` as the column letter for the first result column.



9. Select **OK**.

Lists & Spreadsheet inserts two columns: one containing the names of the results, and one containing the corresponding values.

	A	B	C	D	E
◆				=LinRegMx(a[],b[],	
1	1	7	Title	Linear Regressio...	
2	2	12	RegEqn	m*x+b	
3	3	17	m	5.	
4	4	22	b	2.	
5	5	27	r^2	1.	
6			r	1.	
7			Resid	{0.,0.,0.,0.,0.}	

A1 | 1

Note: The results are linked to the source data. For example, you can change a value in column A, and the regression equation is updated automatically.

Supported Statistical Calculations

The Stat Calculations menu lets you select from the calculations described below. For a complete description of inputs and outputs, refer to the function name (in parentheses) in the TI-Nspire Reference Guide.

One-Variable Statistics (OneVar)

The *One-Variable Statistics* calculation analyzes data with one measured variable. The statistical data returned for a data set using this analysis technique are:

- sample mean, $\bar{x}$
- sum of the data, Σx
- sum of the squared data, Σx^2
- sample standard deviation, s
- population standard deviation, Œ
- sample size, n
- X-min
- first quartile, Q_1

- median
- third quartile, Q_3
- X-max

Each element in *freqlist* is the frequency of occurrence for each corresponding data point in *Xlistname*. *freqlist* elements must be real numbers > 0.

Two-Variable Statistics (TwoVar)

The *Two-Variable Statistics* calculation analyzes paired data. *List 1* is the independent variable. *List 2* is the dependent variable. The statistical data returned for the data sets using this analysis technique are:

For each list:

- sample mean, $\bar{x}$ or $\bar{y}$
- 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, Œx = Œ$_n$x or Œy = Œ$_n$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 = $\Sigma(x-\bar{x})^2$ or SSy = $\Sigma(y-\bar{y})^2$

Additional data:

- sample size for each data set, n
- Σxy

Each element in *freqlist* is the frequency of occurrence for each data pair (*List1*,*List2*).

Linear Regression (mx+b) (LinRegMx)

The **Linear Regression (mx+b)** 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)

The **Linear Regression (a+bx)** 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 Regression (MedMed)

The **Median-Median Line** regression fits the model equation y=ax+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 **a** (slope) and **b** (y-intercept).

Quadratic Regression (QuadReg)

The **QuadReg** (quadratic regression) 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)

The **CubicRegregression** 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)

The **Quartic Regression** 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 (PwrReg)

The **Power Regression** fits the model equation $y=ax^b$ to the data using a least-squares fit and transformed values ln(x) and ln(y). It displays values for **a**, **b**, $\mathbf{r}^2$, and **r**.

Exponential Regression (ExpReg)

The **Exponential Regression** fits the model equation $y=ab^x$ to the data using a least-squares fit and transformed values x and ln(y). It displays values for **a**, **b**, $\mathbf{r}^2$, and **r**.

Logarithmic Regression (LogReg)

The **Logarithmic Regression** fits the model equation y=a+b ln(x) to the data using a least-squares fit and transformed values ln(x) and y. It displays values for **a**, **b**, $\mathbf{r}^2$, and **r**.

Sinusoidal Regression (SinReg)

The **Sinusoidal Regression** 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 in order 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)

The **Logistic Regression** ***(d=0)*** 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**.

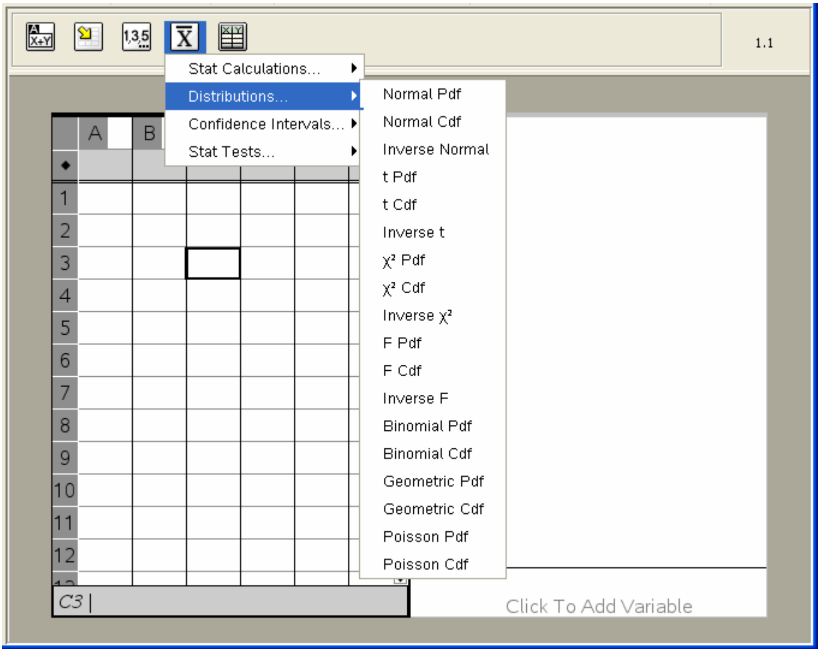
Logistic Regression (d≠0) (LogisticD)

The **Logistic** **(d≠0)** regression 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**, **c** and **d**.

Multiple Linear Regression (MultReg)

The **Multiple Linear Regression** calculates multiple linear regression of list Y on lists X1, X2, …, X10.

Distributions



Supported Distribution functions

The following distributions are available from the Lists & Spreadsheets application. For complete information regarding these functions, refer to the function name (in parentheses) in the TI-Nspire Reference Guide.

Normal Pdf (normPdf)

Normal Pdf 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.

You must select a valid list from the pull-down to avoid unexpected results.

Normal Cdf (normCdf)

Normal Cdf computes the normal distribution probability between *lowerbound* and *upperbound* for the specified mean, μ, and standard deviation, σ. The defaults are μ=0 and σ=1.

This distribution is useful in determining the probability of an occurrence of any value between the lower and upper confidence level in a normal distribution.

Inverse Normal (invNorm)

Inverse Normal computes the inverse cumulative normal distribution function for a given *area* under the normal distribution curve specified by mean, μ, and standard deviation, σ. It calculates the probability of the occurrence below the *x* value for the upper bound of the area. $0 \le area \le 1$ must be true. The defaults are μ=0 and σ=1.

This distribution is useful in determining the probability of an occurrence of data in the area from 0 to x<1.

t Pdf() (tPdf())

t Pdf computes the probability density function (**pdf**) for the Student-*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 in a normally distributed function when the population standard deviation is not known.

t Cdf (tCdf())

t Cdf computes the Student-*t* distribution probability between *lowerbound* and *upperbound* for the specified *df* (degrees of freedom), which must be > 0.

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())

Inverse t computes the inverse cumulative Student-t probability function specified by Degree 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.

χ^2 *Cdf*

χ^2 **Cdf** computes the χ^2 (chi-square) distribution probability between *lowerbound* and *upperbound* for the specified *df* (degrees of freedom), which must be an integer > 0.

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 sample have the same variance.

F *Cdf*

F Cdf(computes the **F** distribution probability between *lowerbound* and *upperbound* for the specified *numerator df* (degrees of freedom) and *denominator df*. *numerator df* and *denominator df* must be integers > 0.

This distribution is useful in determining the probability that two samples within the same bounds have the same variance.

Binomial Pdf (binomPdf())

Binomial Pdf computes a probability at x for the discrete binomial distribution with the specified *numtrials* and probability of success (p) on each trial. x 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:

$$f(x) = \binom{n}{x} p^x (1-p)^{n-x}, x = 0,1,...,n$$

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 5th toss.

Binomial Cdf (binomCdf())

Binomial Cdf computes a cumulative probability at x for the discrete binomial distribution with the specified *numtrials* and probability of success (p) on each trial. x can be a real number or a list of real numbers. $0 \le p \le 1$ must be true. *numtrials* must be an integer > 0. If you do not specify x, a list of cumulative probabilities is returned.

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.

Poisson Pdf (poissPdf())

Poisson Pdf 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 8 tosses of a coin.

poissoncdf (poissCdf())

poissoncdf(computes a cumulative probability at x for the discrete Poisson distribution with the specified mean, μ, which must be a real number > 0. x can be a real number or a list of real numbers.

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.

geometpdf (geomPdf())

geometpdf(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:

$$f(x) = p(1-p)^{x-1}, x = 1,2,...$$

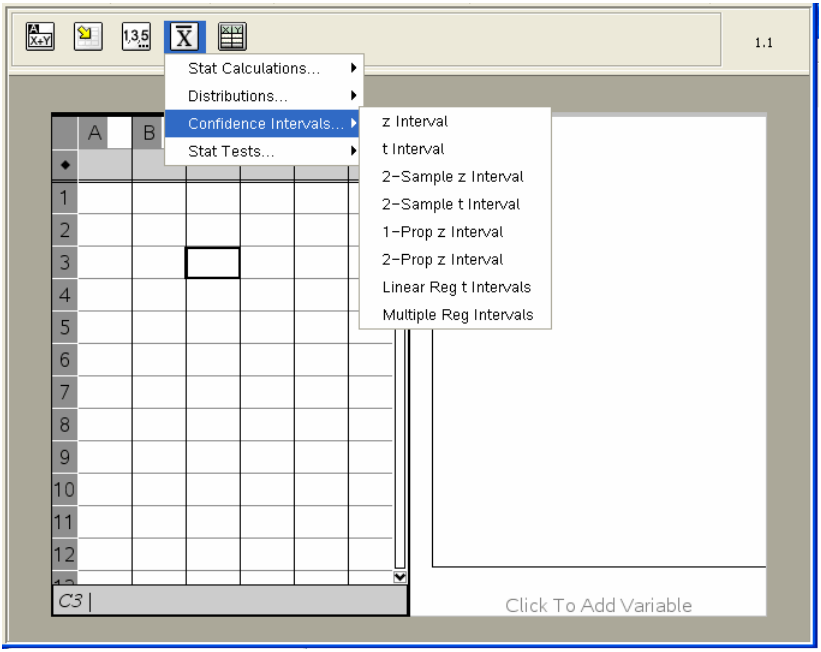
This distribution is useful in determining the likeliest number of trials before a success is obtained. For example, you could use this calculation to predict the number of coin tosses that would be made before a heads resulted.

geometcdf (geomCdf())

geometcdf(computes a cumulative 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 a real number or a list of real numbers.

This distribution is useful in determining the probability associated with the first success occurring during trials 1 -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 complete information regarding these functions, refer to the function name (in parentheses) in the TI-Nspire Reference Guide.

z Interval (zInterval)

z Interval (one-sample z confidence interval) 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 the interval around a population mean. This helps you determine how far from a population mean a sample mean can get before indicating a significant deviation.

t Interval (tInterval)

t Interval (one-sample t confidence interval) 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 if the confidence interval associated with a confidence interval 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)

2-Sample z Interval (two-sample z confidence interval) 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.

2-Sample t Interval (tInterval_2Samp)

2-Sample t Interval (two-sample t confidence interval) 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 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 in order to determine the standard deviation.

1-Prop z Interval (zInterval_1Prop)

1-Prop z Interval (one-proportion z confidence interval) 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)

2-Prop z Interval (two-proportion z confidence interval) 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.

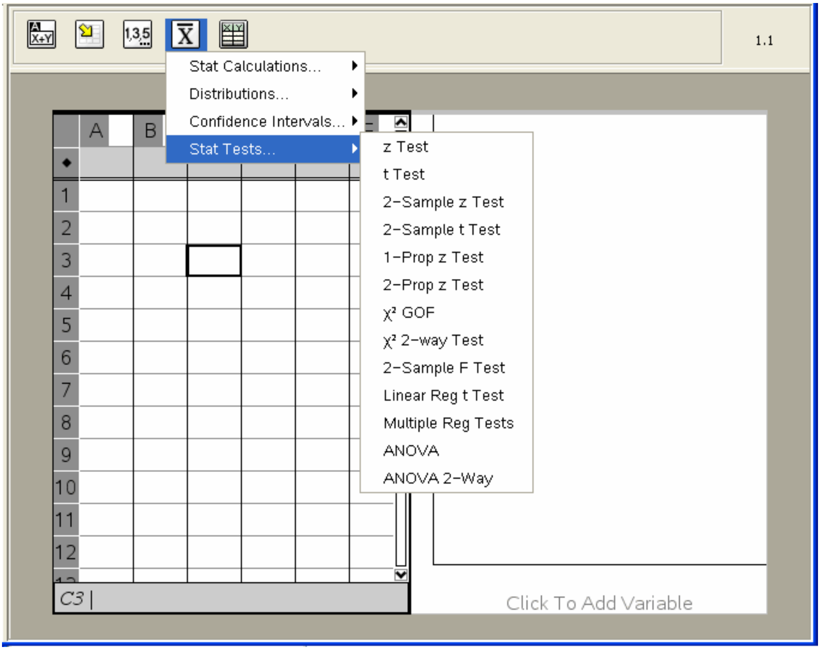
Linear Reg t Intervals (LinRegtIntervals)

Linear Reg t Intervals 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

The following hypothesis tests are available from the Lists & Spreadsheets application. For complete information regarding these functions, refer to the function name (in parentheses) in the TI-Nspire Reference Guide.

Z-test (zTest)

Z-Test (one-sample z test) 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: $\mu\neq\mu_0$ (μ**:**$\neq\mu$**0**)
- H_a: $\mu<\mu_0$ (μ**:<**μ**0**)
- H_a: $\mu>\mu_0$ (μ**:>**μ**0**)

This test is used for large populations that are normally distributed. The standard deviation must be known.

For example, 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)

T-Test (one-sample t test) 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: $\mu\neq\mu_0$ (μ**:**$\neq\mu$**0**)
- H_a: $\mu<\mu_0$ (μ**:<**μ**0**)
- H_a: $\mu>\mu_0$ (μ**:>**μ**0**)

This test is similar to a z-test but is used when the population is small and not normally distributed. This test is used more frequently than is the z-test because small sample populations are more frequently encountered in statistics than are large populations.

For example, 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-SampZTest (zTest_2Samp)

2-SampZTest (two-sample z test**)** 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: $\mu_1\neq\mu_2$ (μ**1:**$\neq\mu$**2**)
- H_a: $\mu_1<\mu_2$ (μ**1:<**μ**2**)
- H_a: $\mu_1>\mu_2$ (μ**1:>**μ**2**)

2-SampTTest (tTest_2Samp)

2-SampTTest (two-sample t test) 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: $\mu_1\neq\mu_2$ (μ**1:**$\neq\mu$**2**)
- H_a: $\mu_1<\mu_2$ (μ**1:<**μ**2**)
- H_a: $\mu_1>\mu_2$ (μ**1:>**μ**2**)

1-PropZTest (zTest_1Prop)

1-PropZTest (one-proportion z test) 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-PropZTest** tests the null hypothesis H_0: prop=p_0 against one of the alternatives below.

- H_a: prop≠p_0 (**prop:≠p0**)
- H_a: prop<p_0 (**prop:<p0**)
- H_a: prop>p_0 (**prop:>p0**)

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-PropZTest (zTest_2Prop)

2-PropZTest (two-proportion z test) 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-PropZTest** 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: $p_1 \neq p_2$ (**p1:≠p2**)
- H_a: $p_1 < p_2$ (**p1:<p2**)
- H_a: $p_1 > p_2$ (**p1:>p2**)

This test is useful in determining if the probability seen in two sames is equal.

χ^2GOF-Test

χ^2GOF**-Test** (Chi Square Goodness of Fit) 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-Test

χ^2**-Test** (chi-square test) 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-SampFTest

2-SampFTest (two-sample **F**-test) 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-SampFTest**, 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: $\sigma_1 \neq \sigma_2$ (**σ1:≠σ2**)
- H_a: $\sigma_1 < \sigma_2$ (**σ1:<σ2**)
- H_a: $\sigma_1 > \sigma_2$ (**σ1:>σ2**)

Below is the definition for the **2-SampFTest**.

$Sx1$, $Sx2$	=	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-SampFTest for the alternative hypothesis $\sigma_1 > \sigma_2$.

$$p = \int_F^{\alpha} f(x, n_1 - 1, n_2 - 1)dx$$

2-SampFTest for the alternative hypothesis $\sigma_1 < \sigma_2$.

$$p = \int_0^{F} f(x, n_1 - 1, n_2 - 1)dx$$

2-SampFTest 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.

LinRegTTest

LinRegTTest (linear regression t test**)** 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 $\rho\neq0$ (β **&** ρ**:** $\neq$**0**)
- H_a: $\beta<0$ and $\rho<0$ (β **&** ρ**:<0**)
- H_a: $\beta>0$ and $\rho>0$ (β **&** ρ**:>0**)

Multiple Reg Tests (MultRegTest)

See Reference Guide (MultRegTests)

Multiple linear regression t test computes a linear regression on the given data, and provides the F test statistic for linearity.

ANOVA

ANOVA((one-way ANalysis Of VAriance) computes a one-way analysis of variance for comparing the means of two to 20 populations. The **ANOVA** procedure for comparing these means involves analysis of the variation in the sample data. The null hypothesis H_0: $\mu_1=\mu_2=...=\mu_k$ is tested against the alternative H_a: not all $\mu_1...\mu_k$ 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 other 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)

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.)

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.

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 indluence 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-SampTTest**.
- The third is a **>** alternative hypothesis, such as p1>p2 for the **2-PropZTest**.

To select an alternative hypothesis, move the cursor to the appropriate alternative, and then press enter.

Selecting the Pooled Option

Pooled (**2-SampTTest** and **2-SampTInt** 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 box.

Statistics Input Descriptions

The following table describes the different inputs used in List & 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.
$\bar{x}$, **Sx**, **n**	Summary statistics (mean, standard deviation, and sample size) for the one-sample tests and intervals.
σ**1**	The known population standard deviation from the first population for the two-sample tests and intervals. Must be a real number > 0.
σ**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.
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**, n**1**, $\bar{x}$**2**, **Sx2**, n**2**	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-SampTTest** and **2-SampTInt**. **No** instructs the TI-Nspire not to pool the variances. **Yes** instructs the TI-Nspire to pool the variances.
$\mathbf{p}_0$	The expected sample proportion for **1-PropZTest**. Must be a real number, such that $0 < p_0 < 1$.

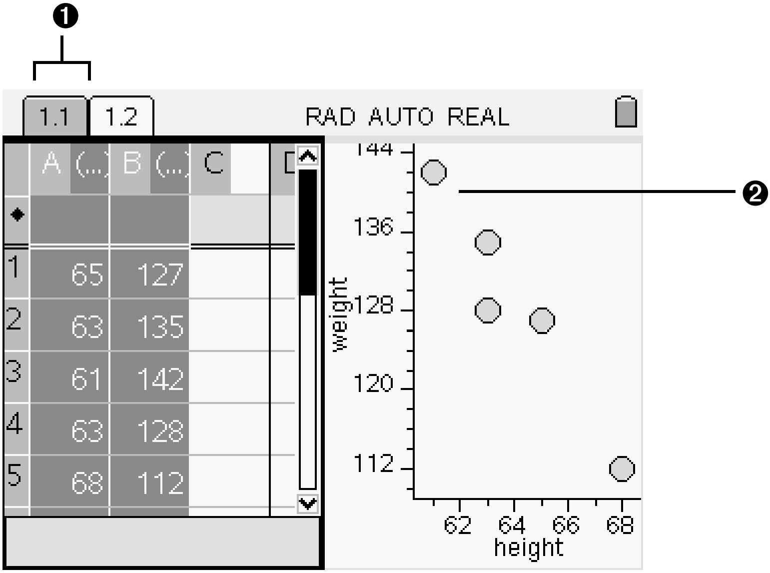
Input	Description
x	The count of successes in the sample for the **1-PropZTest** and **1-PropZInt.** Must be an integer ≥ 0.
n	The count of observations in the sample for the **1-PropZTest** and **1-PropZInt**. Must be an integer > 0.
x1	The count of successes from sample one for the **2-PropZTest** and **2-PropZInt**. Must be an integer ≥ 0.
x2	The count of successes from sample two for the **2-PropZTest** and **2-PropZInt**. Must be an integer ≥ 0.
n1	The count of observations in sample one for the **2-PropZTest** and **2-PropZInt**. Must be an integer > 0.
n2	The count of observations in sample two for the **2-PropZTest** and **2-PropZInt**. 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.
df	df (degree of freedom) represents (number of sample categories) - (number of estimated parameters for the selected distribution + 1).
RegEQ	The prompt for the name of the location where the calculated regression equation is to be stored.

Using Data and Statistics

The Data & Statistics application provides tools to:

- visualize sets of data in different types of plots.
- directly manipulate data sets 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.

Note: In the following example, Lists & Spreadsheet is shown along with Data & Statistics. This represents a typical page set-up.



❶ Problem/Page number counter

❷ Sample Data & Statistics work area

The Tool menu

Press (menu) to open the Tools menu. These menus and tools enable you to graph and explore data, modify data presentations by using different plots, as well as perform and plot statistical analyses.

The following tables describe what each tool does in the Data & Statistics work area.

Tool Menus

Menu	Overview of Tool Actions
Plot type	Provides access to the different plot types available in the Data & Statistics application.
Plot properties	Allows you to specify how the plot displays
Actions	Lets you add/remove items to your work area. This includes movable lines for manually fitting data, regression curves and functions.
Window/Zoom	Lets you specify a zoom factor for the window, or determine min and max values for the horizontal and vertical axes.

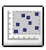
Plot Types Menu Tools

Tool name	Tool function
Dot Plot	Depicts data in a dot plot. This is the default plot type for a single variable of the data set.
Box Plot	Displays data in a box plot.
Histogram	Displays data in a histogram.
Scatter Plot	Displays data in scatter plot form. This is the default plot type for two variables of the data set.
X-Y Line Plot	Displays data as an x-y line plot.

Plot Properties Menu Tools

Tool name	Tool function
 Connect Data Points	Draws a line between each point on a scatter plot. Lines are connected in the order of data entry in the horizontal axis data set. This is the same as the X-Y Line plot type
Histogram Scale:	Determines how the histogram data displays in the work area.
Count	Displays data in the histogram by occurrence in the data set.
Percent	Displays data in the histogram by each bin's percent value of the whole data set.
Density	Displays data in the histogram by data density.
Extend Box Plot Whiskers/ Show Box Plot Outliers	Extend Box Plot Whiskers extends the whiskers to the min and max of the data. Show Box Plot Outliers stops at 1.5* Interquartile Range and shows outliers as individual dots. Note: If there are no points outside of 1.5* Interquartile Range, there may appear to be no whisker change.
 Remove X Variable	Removes the display of the variable assigned to the horizontal axis without changing the vertical axis.
 Remove Y Variable	Toggles the display of the variable assigned to the vertical axis without changing the horizontal axis.

Actions Tool menu

 Select all Points	Selects all points in the work area.
 Add Movable Line	Adds a line you can position and reposition in the work area. This can be used for manual fit.

Remove Selected	Removes the selected object. Changes to Remove Movable Line, Remove Regression, Remove Plotted Value, Remove Plotted Function, depending on what is selected.
Lock Intercept at Zero/Unlock Movable Line Intercept	Locks the intercept of the movable line at zero. **Note:** This tool is only available when a movable line or regression line is present in the work area.
Regression	The regression tools perform the selected regression calculation and then plot the regression model. Regressions are only available on Scatter plots of X-Y line plots.
Show/Hide Linear (mx+b)	Calculates and displays the linear regression line in the format, m*x*+b, for the plotted data.
Show/Hide Linear (a+bx)	Calculates and displays the linear regression line in the format, a+b*x*, for the plotted data.
Show/Hide Median-Median	Calculates and displays the Median-Median regression line for the plotted data.
Show/Hide Quadratic	Calculates and displays the Quadratic regression model for the plotted data.
Show/Hide Cubic	Calculates and displays the Cubic regression model for the plotted data.
Show/Hide Quartic	Calculates and displays the Quartic regression model for the plotted data.
Show/Hide Power	Calculates and displays the Power regression model for the plotted data.
Show/Hide Exponential	Calculates and displays the Exponential regression model for the plotted data.
Show/Hide Logarithmic	Calculates and displays the Logarithmic regression model for the plotted data.
Show/Hide Sinusoidal	Calculates and displays the Sinusoidal regression model for the plotted data.

Show/Hide Logistic (d=0)	Calculates and displays the Logistic regression model where D=0, for the plotted data.
Show/Hide Logistic (d≠0)	Calculates and displays the Logistic regression model where D≠0, for the plotted data.
Show/Hide Residual Squares	Displays the squares of residuals. **Note:** This tool is only available when a regression line or movable line is present in the work area.
Show Normal PDF	Graphs the normal distribution function of the data currently plotted.
Plot Value	Lets you graph a statistical value on the axis. Examples of values that can be plotted are mean, median, standard deviation.
Plot Function	Lets you graph a function in the work area.
Start Over	Erases the content on the page without saving any work. This enables you to start your work again.

Window/Zoom Menu Tools

Tool name	**Tool function**
Window Settings	Displays a Window Settings dialog that enables you to enter the *x*-min, *x*-max, *y*-min, and *y*-max values for the axes.
Zoom - Data	Adjusts the zoom factor so that all plotted data appears in the work area.
Zoom In	Enables you to zoom in on a plot based upon the selection of a center point. The Zoom In factor is approximately 2.
Zoom Out	Enables you to zoom out on a plot based upon the selection of a center point. The Zoom Out factor is approximately 2.

Getting started with Data & Statistics

The Data & Statistics application is designed as a place to explore and visualize data and graph inferential statistics. It is, therefore, best used in conjunction with a numerical application like Calculator or Lists & Spreadsheet.

Creating plots from spreadsheet data

The Quick Graph feature of Lists and Spreadsheet is the easiest way to plot data using the columns in a spreadsheet.

Plotting data from Lists & Spreadsheet

1. Create or display data to be plotted in Lists & Spreadsheet. You can plot one or two columns of data.

   The example below illustrates two named columns, **height** and **weight**.

	A height	B weight	C	D	E	F	G	H	I
◆									
1	65	127							
2	63	138							
3	61	125							
4	68	167							
5	59	110							
6	63	132							
7	62	143							
8	60	115							
9	61	134							
10	63	160							
11	65	154							
12	65	130							

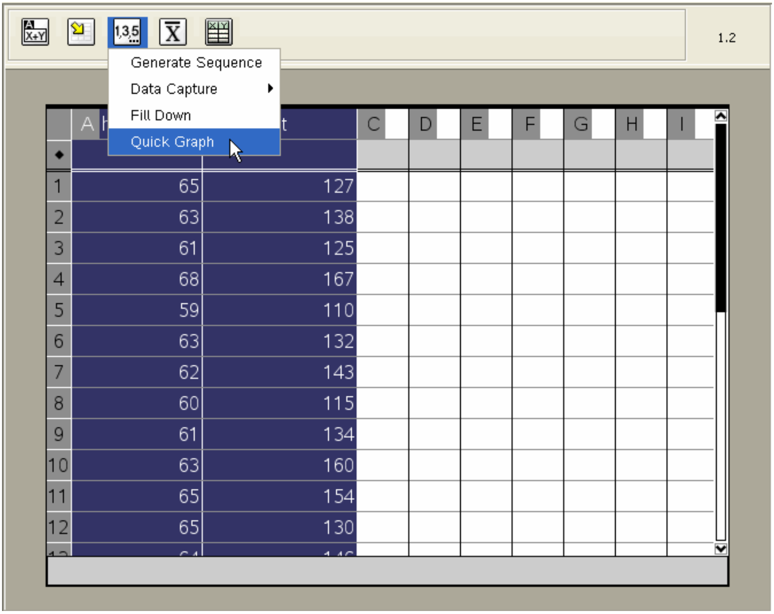
B | **weight**

   Important: You must name each column of data in Lists & Spreadsheet in order to plot the data in Data & Statistics.

2. Highlight at least one column of data in Lists & Spreadsheet.

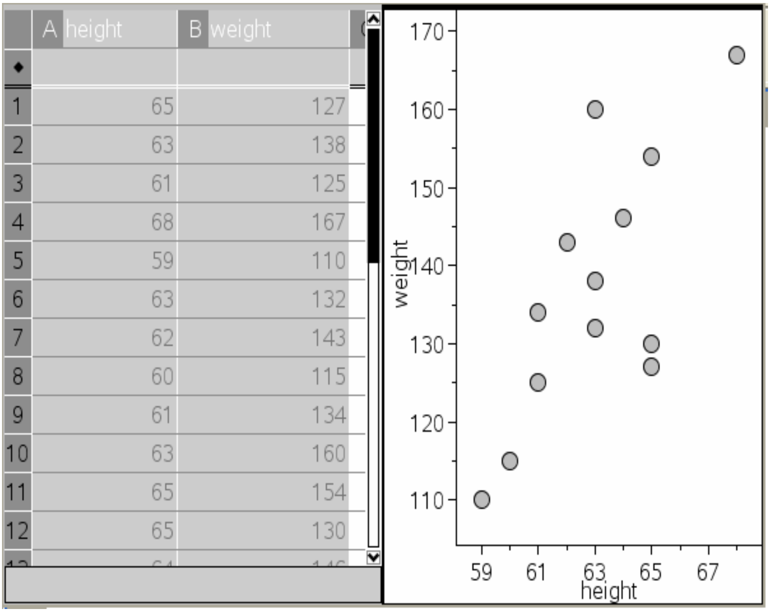
3. From the Lists & Spreadsheet Data menu 1,3,5..., select the Quick Graph tool.

   Press menu 3 5.



The data plot displays in the Data and Statistics work area.

The example below illustrates the plot of two columns of data, which display as a scatter plot. The leftmost column of data in the spreadsheet becomes the horizontal axis values, and that column name becomes the horizontal axis label.



If you select only one column of data, it displays as a dot plot on the horizontal axis. The column name appears as the horizontal axis label.

If there are less than four work areas on the page, TI-Nspire adds a new work area with Data & Statistics active on it.

If four work areas are already defined on the page, TI-Nspire adds a new page to the problem with Data & Statistics active on it.

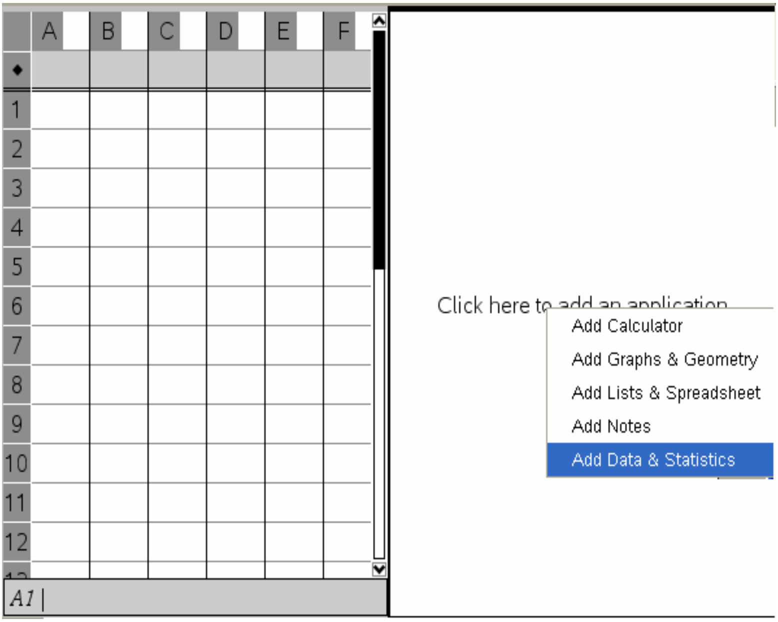
Note: If a list is defined with a formula in Lists & Spreadsheet, the points in Data & Statistics may not move, due to the formula's restriction. The dots in Data & Statistics will only move in directions allowed by their definition, so if they are just data they will move freely. If the points are y=x, they will move along the line.

Creating a split page with Data and Statistics and Lists and Spreadsheet

1. Add the Lists & Spreadsheet or Calculator application to a new page or problem.
2. Click Page Layout and select Layout 2, to split the page into two work areas.

   Press ctrl home 6 2 2.

3. Click to add the Data and Statistics Application to the right side of the work area.



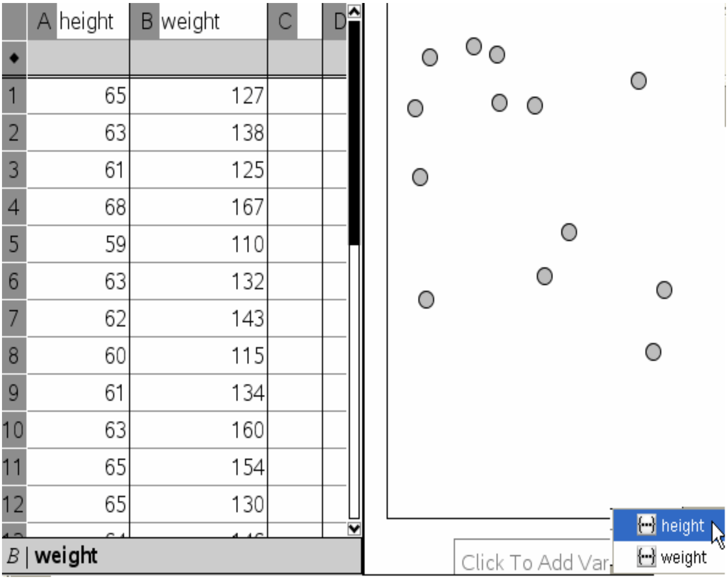
Plotting the contents of linked variables

You can also plot data quickly by using the contents of variables. Data is linked and shared between Data & Statistics and all other TI-Nspire applications within the same problem. When data sets are named, the set is stored as a variable. Selecting the variable name is the method of entering data into the Data & Statistics application. See the Working with Documents chapter for details about storing data as variables.

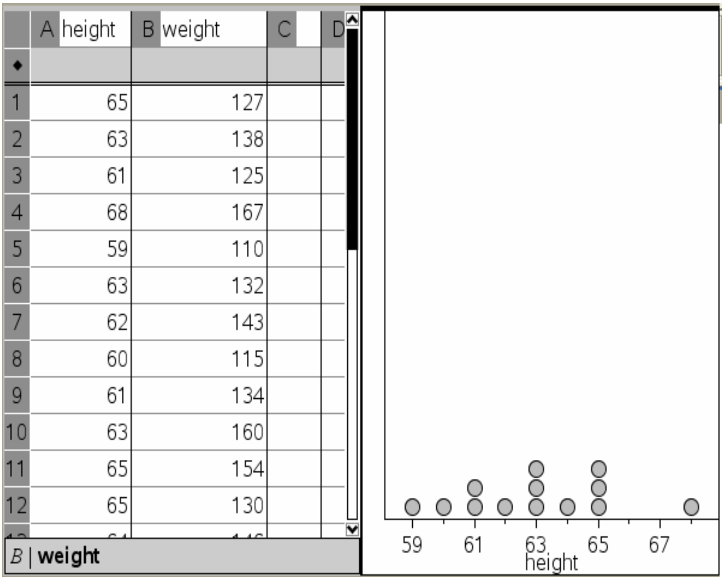
When you name columns in Lists and Spreadsheet (as in the previous example), the contents of the column are saved as a list in a variable. The named columns in this example are saved as variables **height** and **weight**.

1. Insert a new page, and create a split page layout with Lists and Spreadsheets and Data and Statistics.

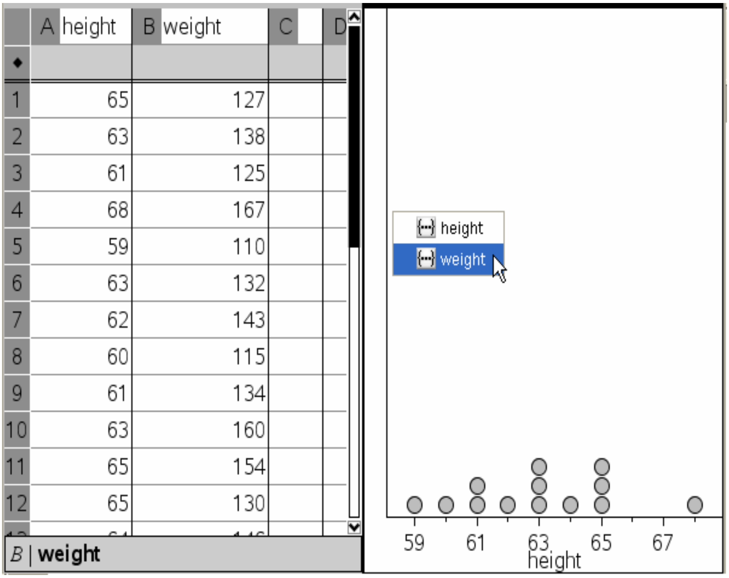
2. On the Data & Statistics work area, click Click To Add Variable and select the name of the data set you want to plot on the horizontal axis.



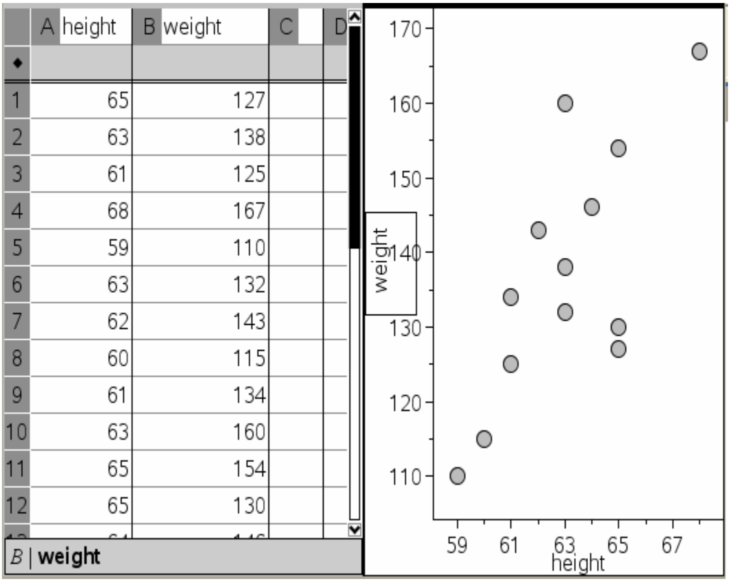
The example below illustrates the value of the column named **height** plotted on the horizontal axis of the Data and Statistics work area.



To create a scatter plot, hover in the middle of the vertical axis until a + appears. Click the label area of the vertical axis and select a second data set name.



The contents of the columns **height** and **weight** are plotted as a scatter plot.


A height
B weight
C
D
1 65 127
2 63 138
3 61 125
4 68 167
5 59 110
6 63 132
7 62 143
8 60 115
9 61 134
10 63 160
11 65 154
12 65 130
B | weight
170
160
150
140
130
120
110
weight
59
61
63
65
67
height

Plot types

Plots let you visualize your data set in a variety of ways. Visualizing the data points allows you to observe the shape and spread of the data, and can help you determine the best method of statistically evaluating data.

Use Data & Statistics to create the following types of plots:

- Dot
- Box
- Histogram
- Scatter
- X-Y Line

Dot plots

Dot plots, also known as dot-frequency plots, represent one variable data. Dot plots are the default plot type in Data & Statistics.

When one data set 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. By default, the horizontal axis is selected. The column name is used as the axis label.

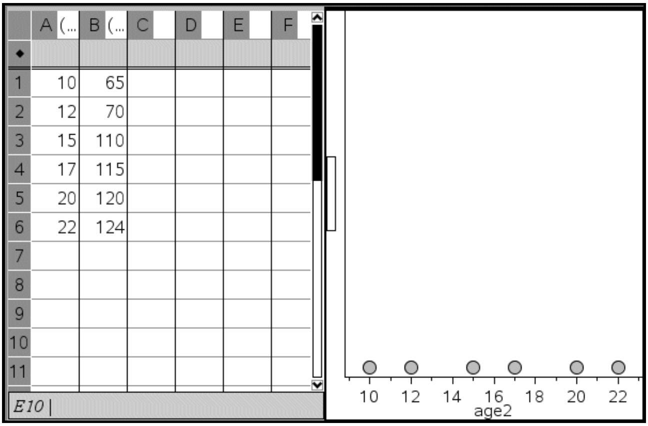
Creating a dot plot

1. Create and name a list of data in a column in Lists & Spreadsheet or Calculator.
2. To create a dot plot, do one of the following:
   - Select the column of data in Lists & Spreadsheet by clicking the grey area next to the column name.

     In the Lists & Spreadsheet work area, select Quick Graph from the Data tool menu to automatically graph the selected data.

     Press menu 3 5.

     OR
   - Click in the horizontal axis label in the Data & Statistics work area, click and select the name of the variable containing the data you want to see represented on the horizontal axis.
3. The data graphs in the Data & Statistics work area.



Click on any dot to display its value.

Box plots

The default boxplot created by the Boxplot Tool is a modified boxplot. It plots one-variable data. "Whiskers" extend from each end of the box, either 1.5 times the interquartile range or to the end of the data, whichever comes first. Points that are 1.5 ∗ Interquartile Range beyond the quartiles are plotted individually beyond the whisker. (The Interquartile Range is defined as the difference between the third quartile, Q3, and the first quartile, Q1.) These points are called potential outliers.

When no outliers exist, *x*-min and *x*-max are the prompts for the end of each whisker (the prompts will be y-min and y-max if you choose to create a vertical box plot). Q1, Med (median), and Q3 define the box.

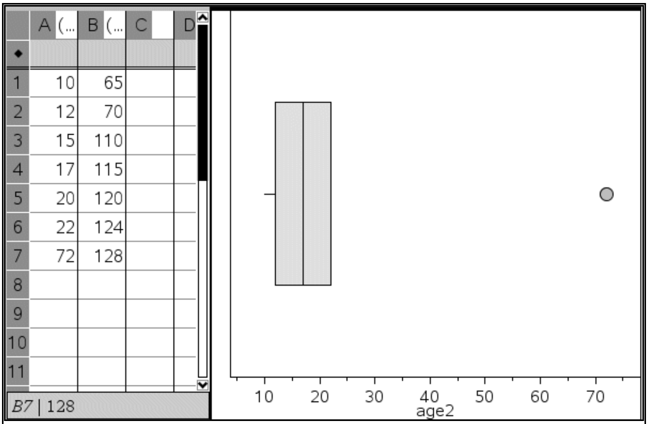
Box plots are plotted with respect to *x*-min and *x*-max, but ignore *y*-min and *y*-max.

Boxplots are useful in comparing two or more sets of data. Note that these must use the same scale. If a data set is large, a boxplot can also be useful in exploring data distribution.

Creating a boxplot

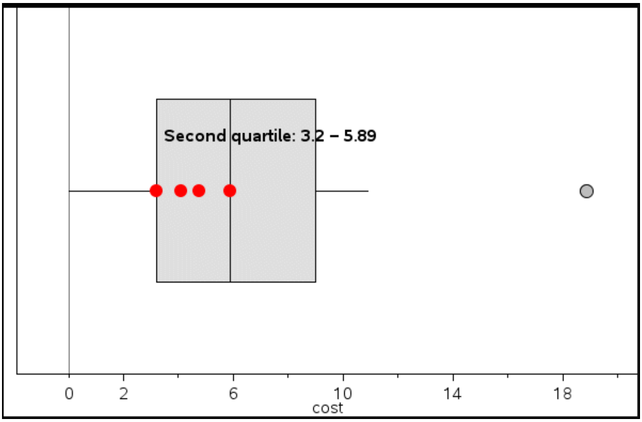
1. If two data sets are plotted in the work area, select Remove Y Variable from the Plot Properties tool menu .
2. From the Plot Types menu , select the Box Plot tool .

   Press menu 1 2.
3. The modified box plot displays.



Initial boxplot display- Modified Boxplot

4. Click on a box or whisker to display the points that make up that portion of the plot and display the range of the data in that portion of the plot.



Creating a standard boxplot

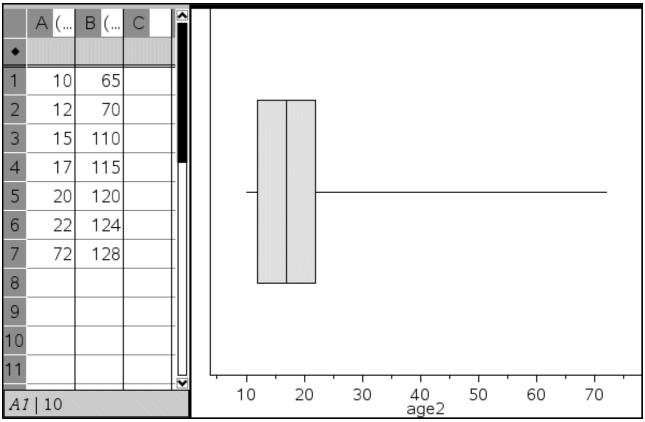
You create a standard boxplot by modifying the whiskers of the default (modified) boxplot. In a standard boxplot, the whiskers are plotted using the minimum and maximum points in the data set. No attempt is made to identify outliers. The whiskers on the plot extend from the minimum data point in the 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. See the Definitions section at the end of this chapter for a definition of Quartile.

To change the boxplot from modified to standard

1. Create a boxplot for one variable by selecting the Boxplot tool  from the Plot Types menu .
2. Right-click to display the context menu,and select Extend Box Plot Whiskers.

   Press menu 2 3

   The box plot is redrawn to display the whiskers you selected.

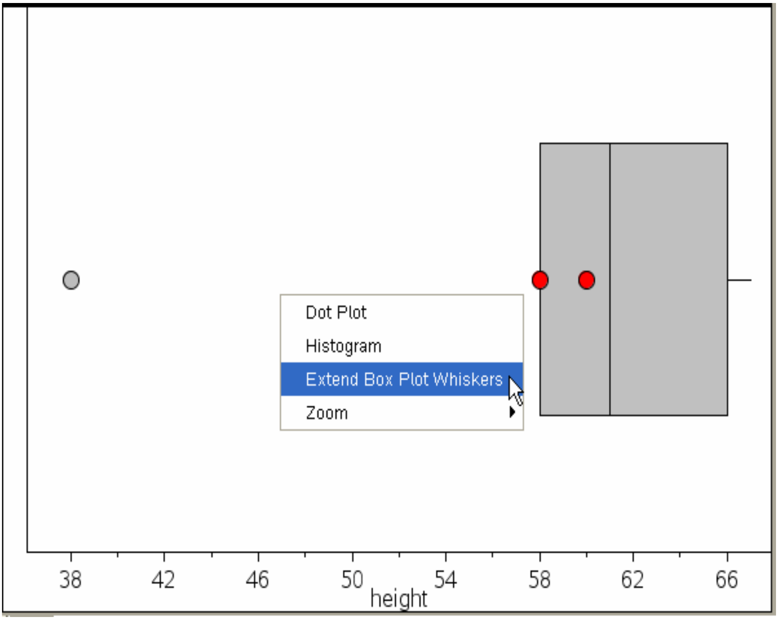


To return the boxplot to its original display, right-click to display the context menu and select Show Box Plot Outliers.

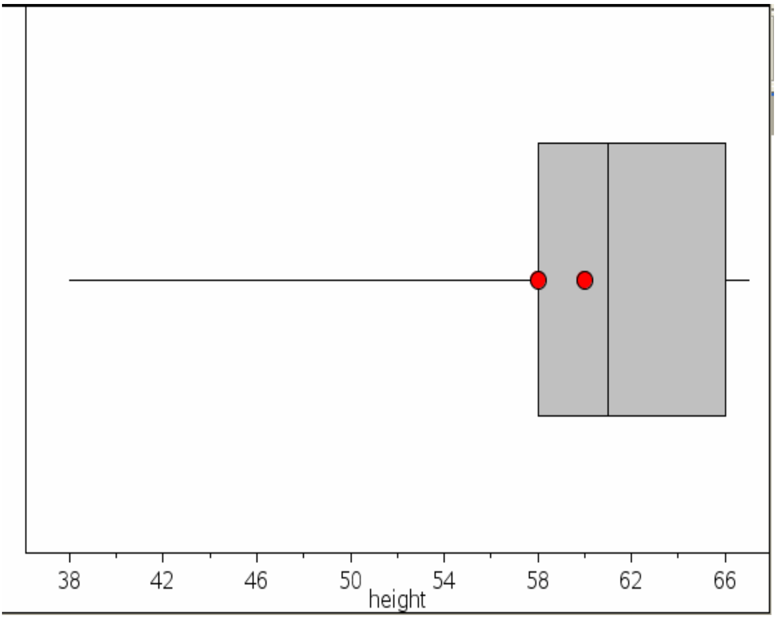
Press menu 2 3.

Extending Box Plot Whiskers

You can select Extend Box Plot Whiskers from the Plot Properties tool menu  to extend the whiskers to the min and max of the data. You can also right-click and select Extend Box Plot Whiskers from the context menu, as shown in the example below.

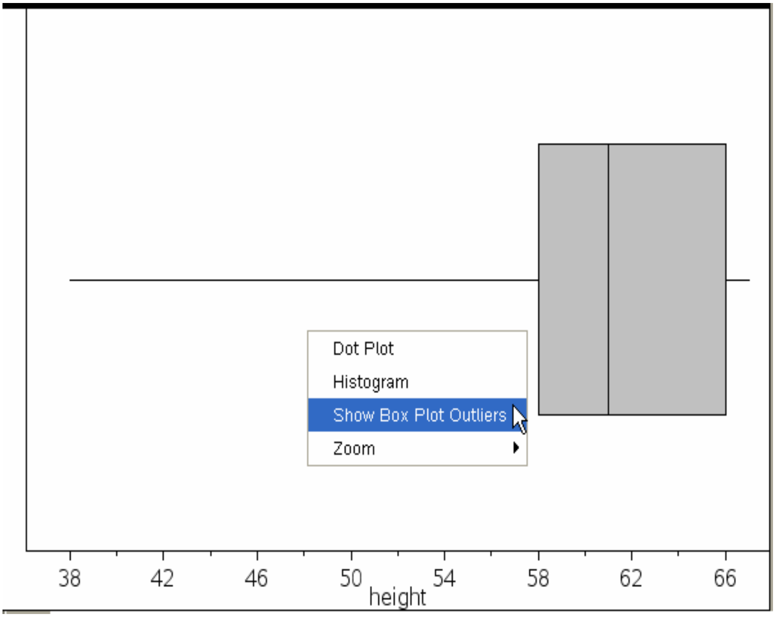


The whiskers extend to the min and max of the data.

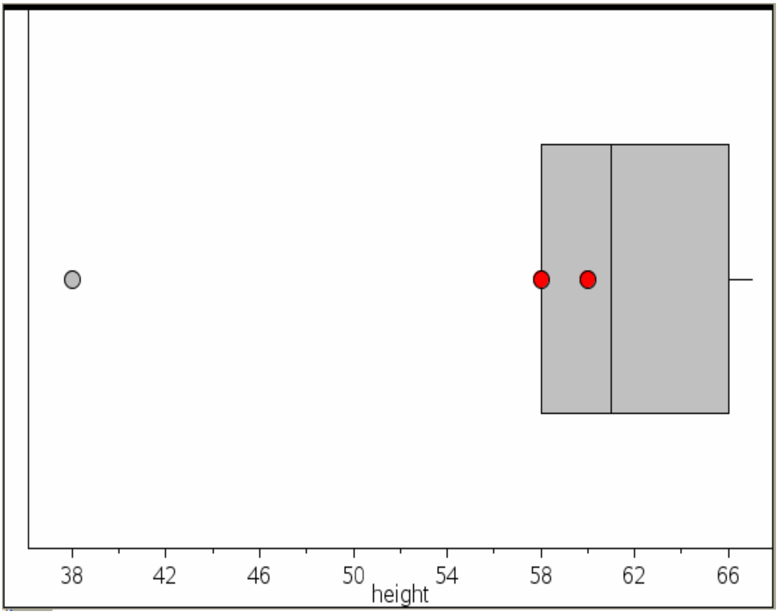


Showing Box Plot Outliers

Select Show Box Plot Outliers from the Plot Properties tool menu  to stop whiskers at 1.5* Interquartile Range and show outliers as individual dots. You can also right-click and select Show BoxPlot Outliers from the context menu.



Points beyond 1.5* Interquartile Range display in the work area.



Note: If there are no points outside of 1.5* Interquartile Range, there may appear to be no change in the whisker display.

Histograms

A histogram plots one-variable data. Histograms depict the distribution of data.

The number of bins displayed depends upon the number of data points and the distribution of these points. You can adjust the bins' width and number by dragging the side of one bin in the work area.

A value that occurs on the edge of a bin is counted in the bin to the right. Each bin width can be adjusted by clicking and dragging the side of the bin.

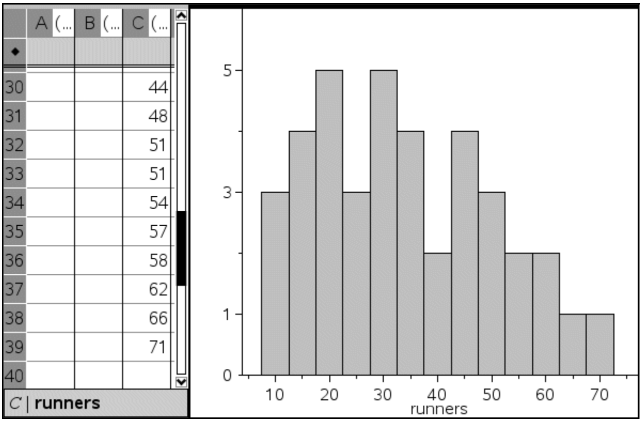
Creating a histogram

1. Select the data you want to plot as a histogram.

2. From the Plot Types menu , select the Histogram tool .

   Press (menu) ‹1› ‹3›.

3. The histogram plots on the Data & Statistics work area.

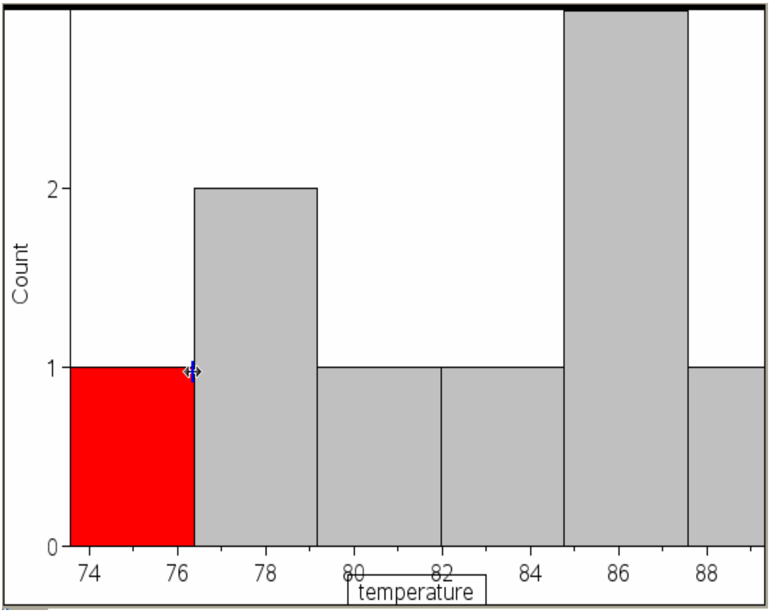


Initial histogram display

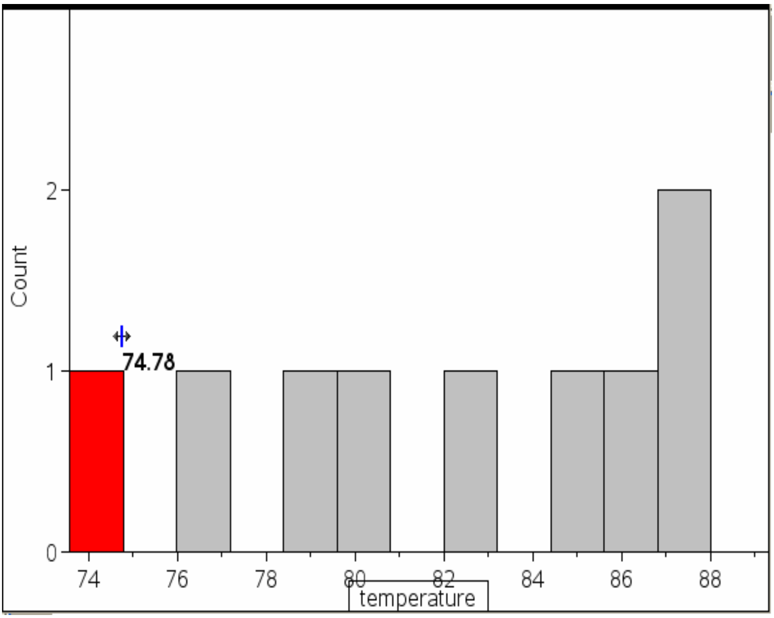
Adjusting the bin width

1. Click the right side of the bin.

   The cursor changes to .



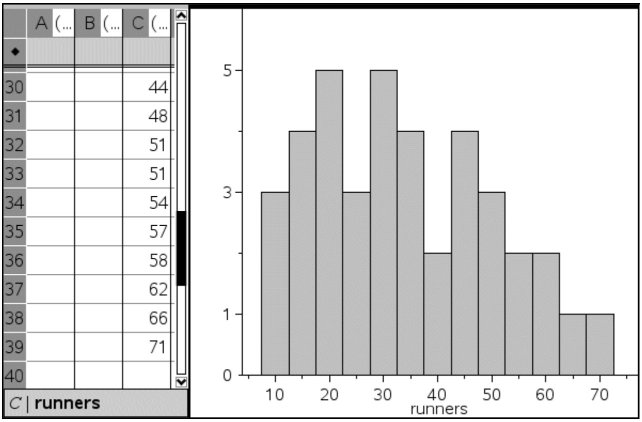
2. Drag the bin to the desired location and release it.



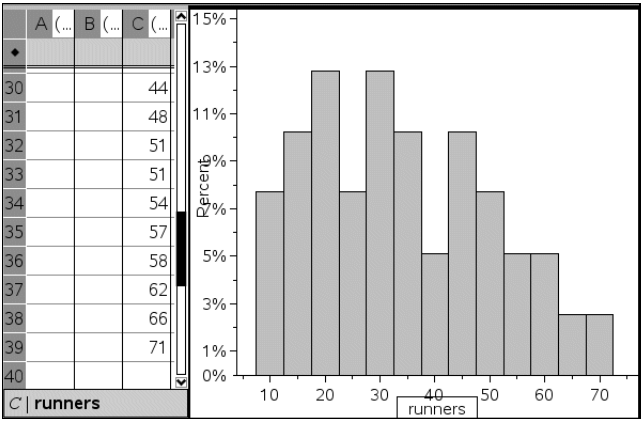
Changing the scale of a histogram:

Use the histogram scale tools to change the data representation format in a histogram. The options for scale are:

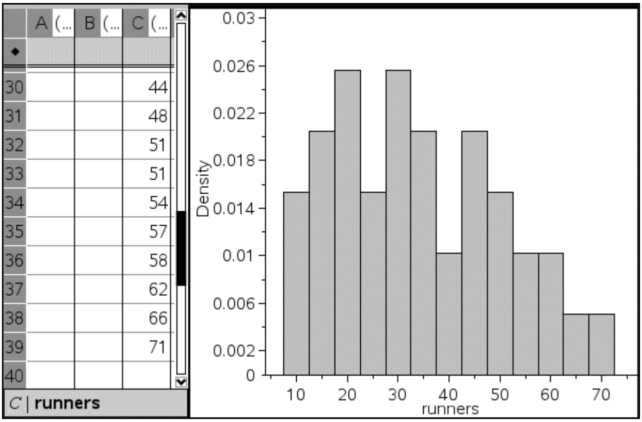
- **Count** - displays data based upon the number of values that occur within each bar (interval or bin) on the histogram. This is the default data representation when you create a histogram.



- **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 value within the data set.



To change the scale:

1. Create a histogram.

2. From the Plot Properties menu, select Histogram Scale, or right-click to select Histogram Scale from the context menu.

   Press menu 2 2.

3. From the Histogram Scale menu, select Percent (2) or Density (3). The histogram is redrawn to the scale you select.

   Note: The Count tool (1)is not available because it is the scale currently used in the display.

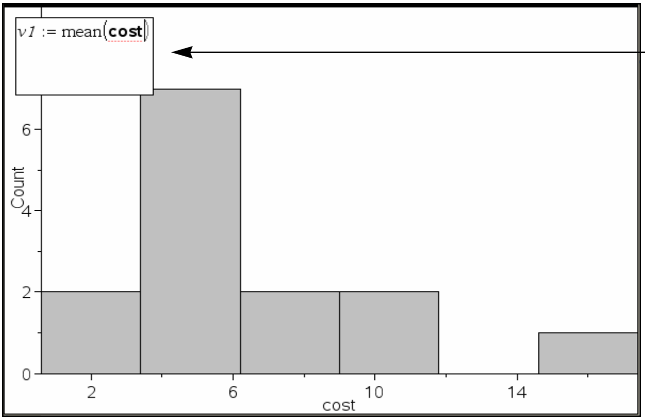
Click on a bin to display the values that are contained in the bin.

Plotting a value

You can plot a value on an existing plot. It displays as a line, perpendicular to the axis, in the work area.

1. From the Actions tool menu, select Plot Value. A data entry box opens in the work area.

   Press menu 3 8.



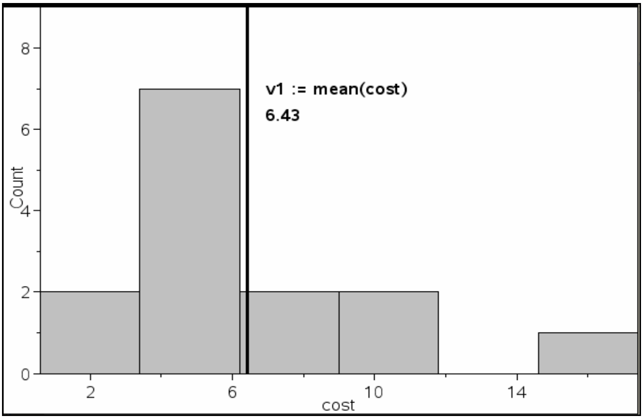
Plot value entry box

2. Type the value you want to plot, and press enter.

   In this example, the value is v1:= mean(cost).

3. The a line is drawn at that value, perpendicular to the axis. Click on the line to display the value.

   Note: The value line cannot be moved in the work area.



Plot value line with value displayed

Plot value can be 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 Lists & Spreadsheet, the line updates to reflect the change, allowing for investigation of the influence of points on the calculation.

Removing a plotted value

To remove a plotted value from the work area, click on the line to select it, and then select Remove Plotted Value from the Actions tool menu.

Press menu 2 4.

Scatter Plots

A scatter plot shows the relationship between two variables of the data or two sets of data.

You can plot bivariable data in either or two ways.

From the Lists & Spreadsheet work area:

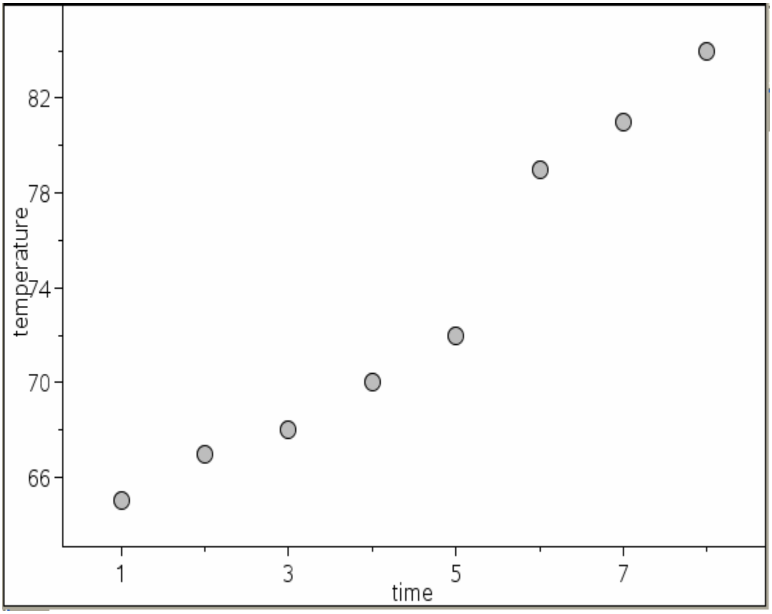
1. Select two columns of data listed in Lists & Spreadsheet by clicking letter above the column.
2. Select Quick Graph tool from the Data tool menu to automatically graph the selected data.

   Press menu 3 5.

3. Select Scatter Plot from the Plot Type menu.

   Press menu 1 4.

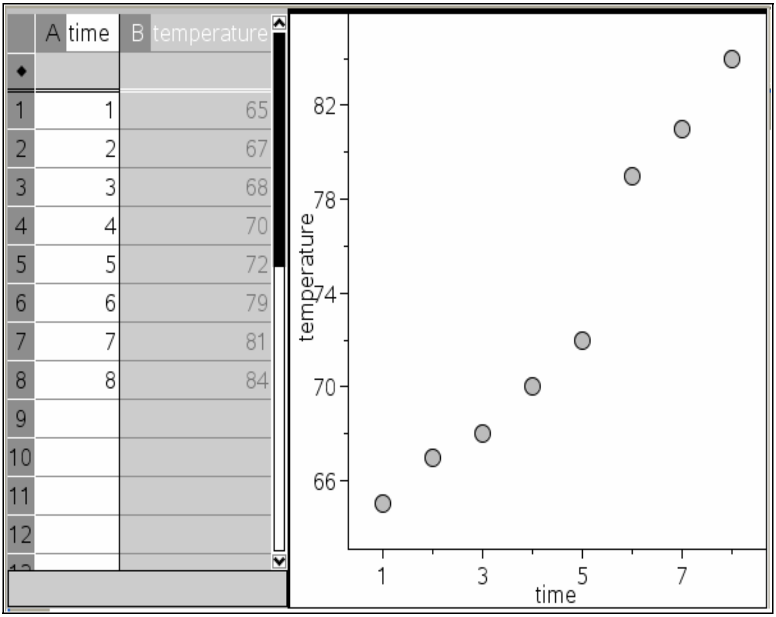
4. The data graphs on the Data & Statistics work area.



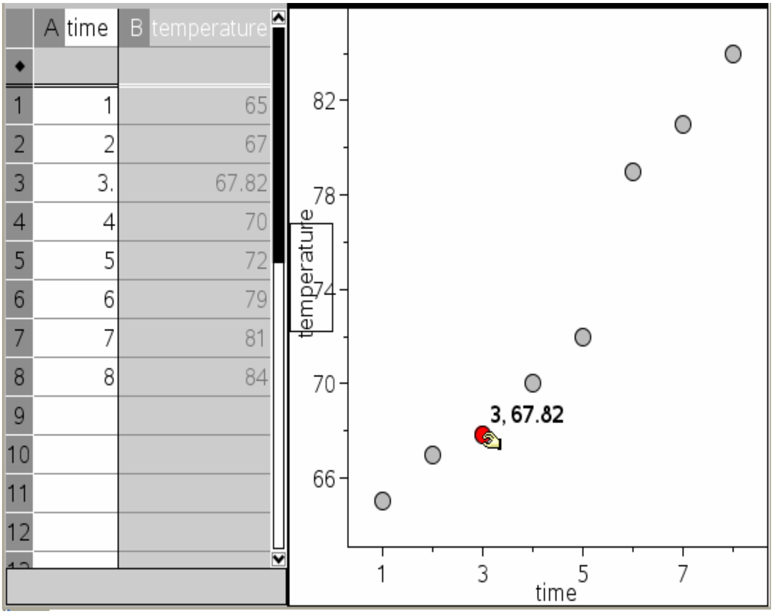
From the Data & Statistics work area:

1. In the Data & Statistics work area, click in the horizontal axis label box, and select the variable that contains the data you want to see represented on the horizontal axis.
2. Click the vertical axis label area, and select the variable that contains the data you want to see represented on the vertical axis.

   The data graphs in the Data & Statistics work area.



3. Click on any point to display its value.



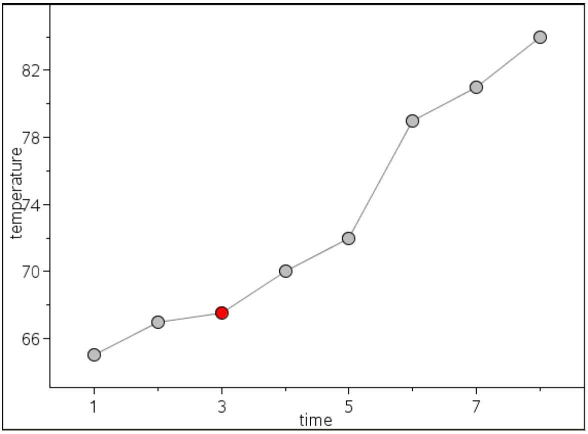
X-Y line plots

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 data sets. 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. Select two columns of data on the Lists & Spreadsheed work area.
2. Click the Data & Statistics work area, and from the Plot Types menu , select the XY Line Plot tool .

   Press menu 1 5.
3. The data points within each set are connected to each other by a line.



Exploring data

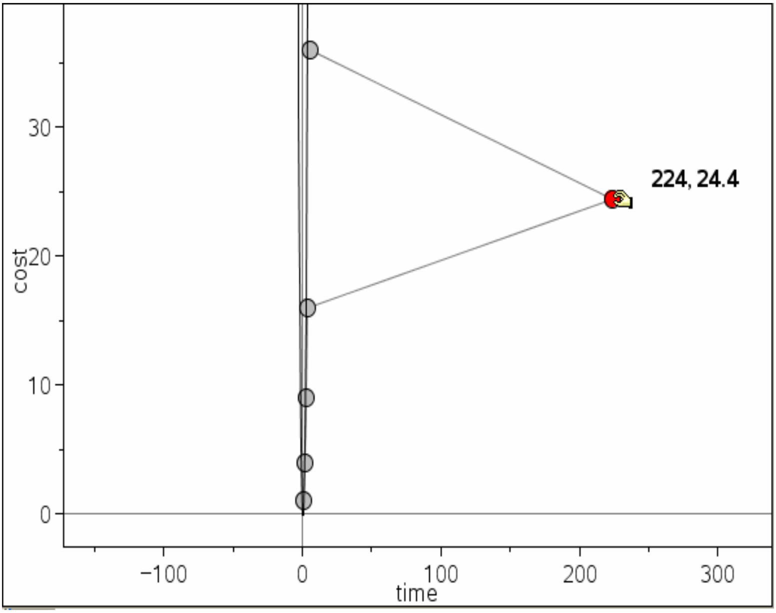
You can manipulate and explore plotted data in the following ways:

- grabbing and moving selected points or data bins.
- changing the type of plot.
- resizing the graph.
- adding a movable line.
- showing regression lines.

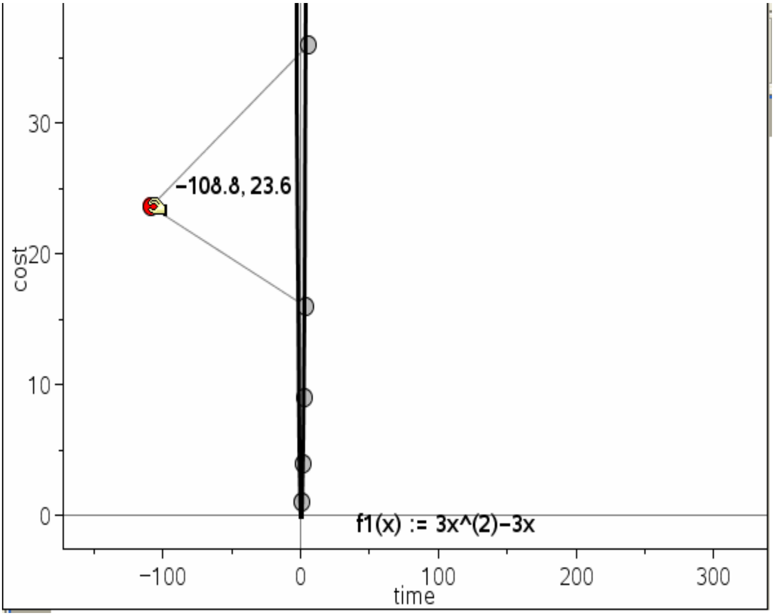
Moving points or bins of data

1. Click on and hold the desired point or bin.

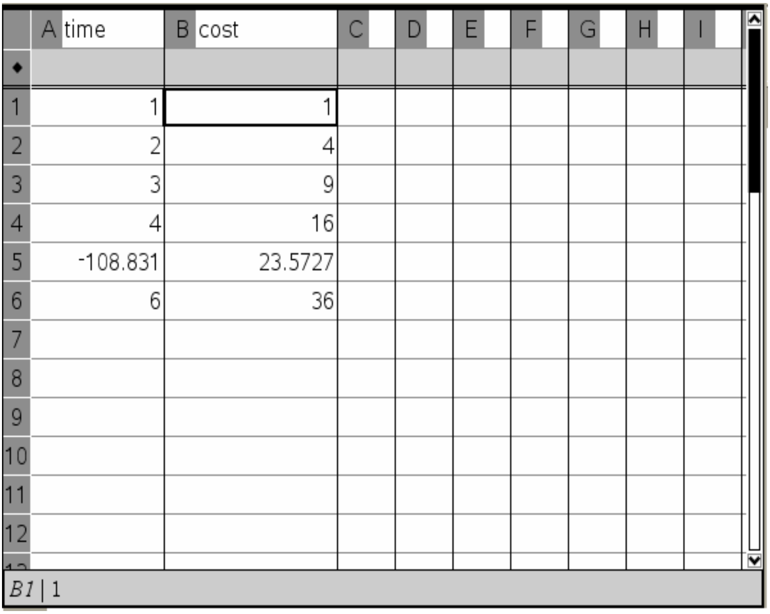
   The cursor changes to ☝.



2. Drag the point or bar to the new location and release it.



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.



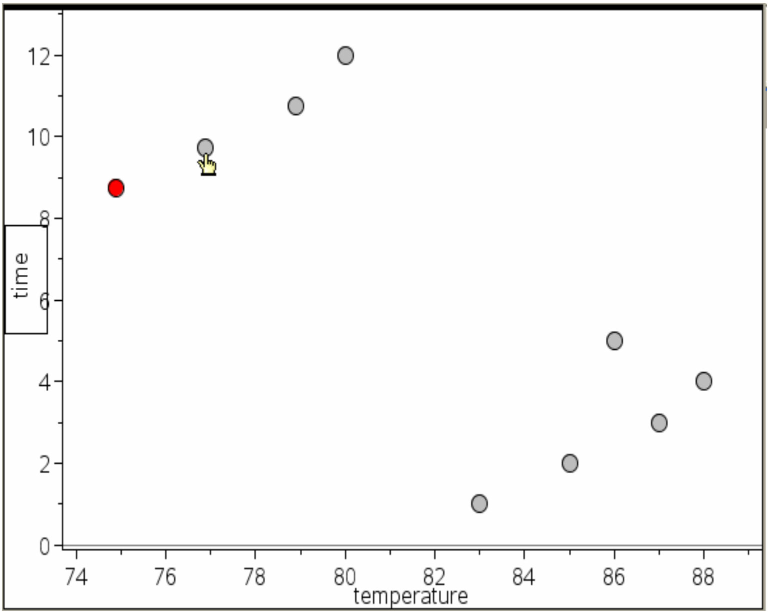
	A time	B cost	C	D	E	F	G	H	I
◆									
1	1	1							
2	2	4							
3	3	9							
4	4	16							
5	-108.831	23.5727							
6	6	36							
7									
8									
9									
10									
11									
12									

B1 | 1

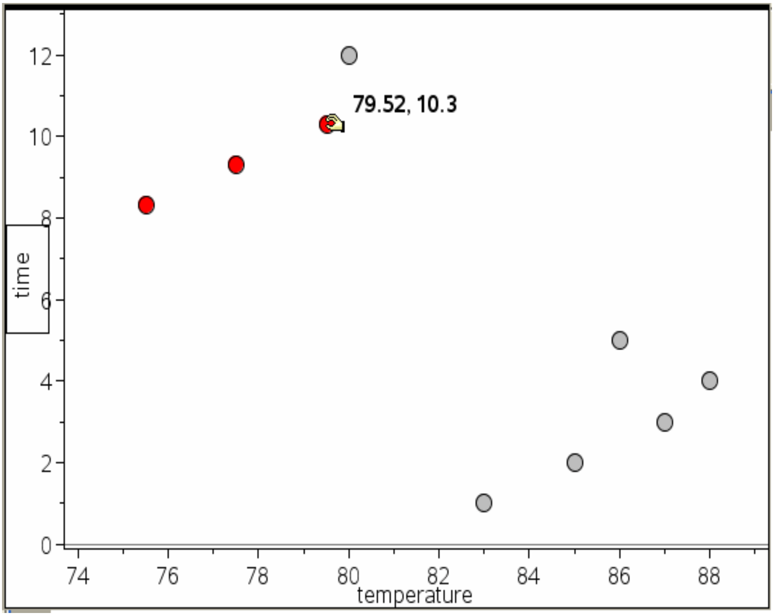
You can also move points or bins by changing the numbers in Lists & Spreadsheet or Calculator. Data will update in all of the representations.

Selecting multiple points

1. Position the cursor over each point you want to select. The cursor changes to .

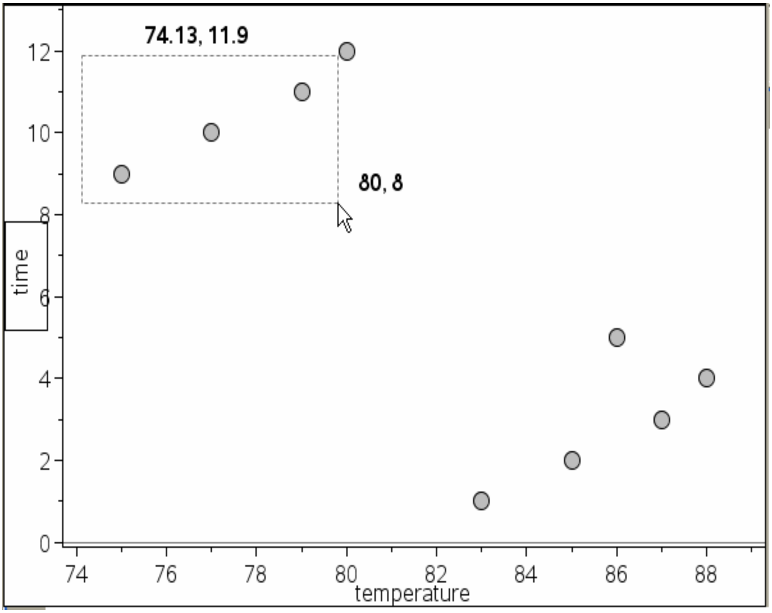


2. Once you have selected the desired points, click one of the points. The cursor changes to ☜, and you can move the points around in the work area.



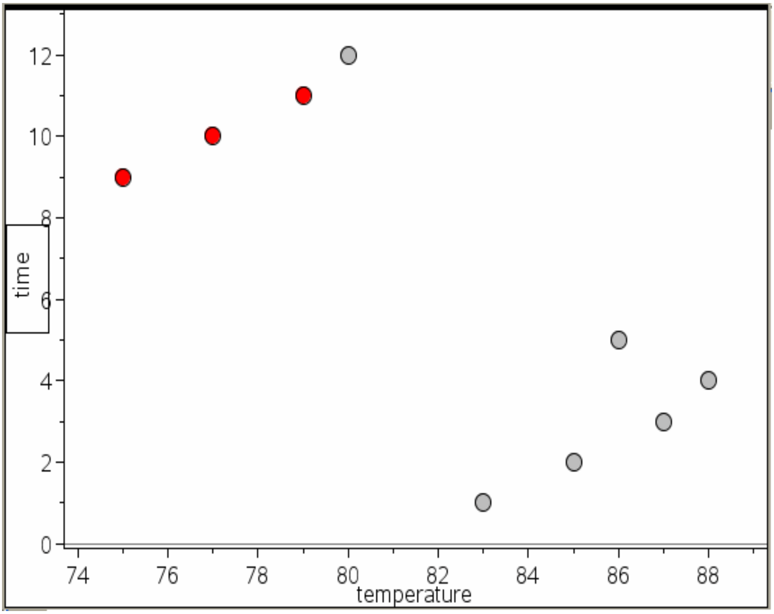
Selecting a range of points

1. Select a range of points by clicking and dragging the box to contain the points you want to select.



When you release the mouse button, the points are selected.

2. Once you have selected the desired points, click one of the points. The cursor changes to ☝, and you can move the points around in the work area.



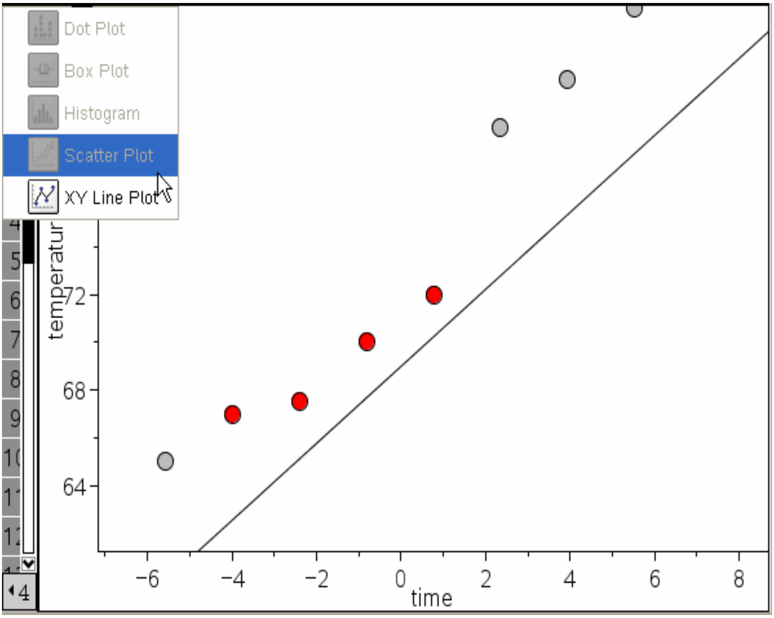
Note: When a list is defined in Lists & Spreadsheet as a formula, the movement of points is restricted to only points that satisfy that formula.

Changing plot type

You can change the plot type, to view different representations of data.

- Display the Plot Types menu , and select the new plot type. The data representation changes to the new plot format.

  Note: Options are greyed out on the menu if your 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 Y component of the plot.



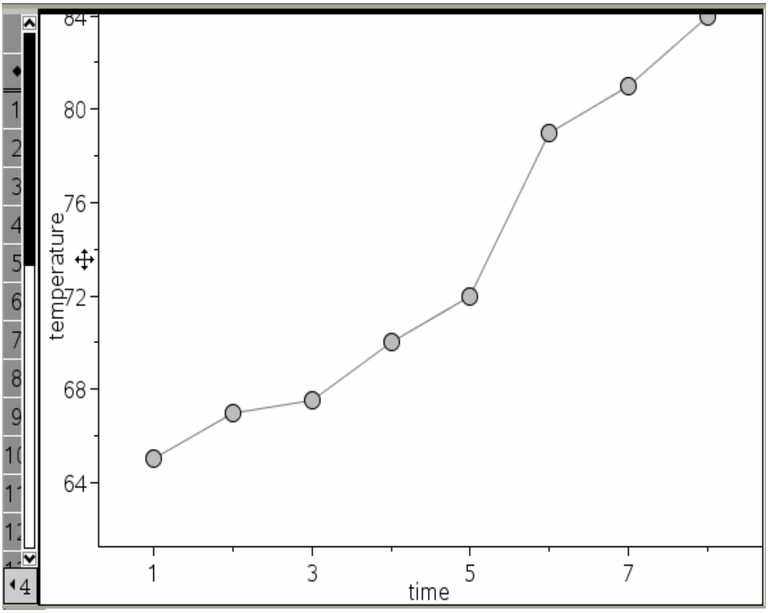
Rescaling a graph

You can change the scale of the axes in a few ways.

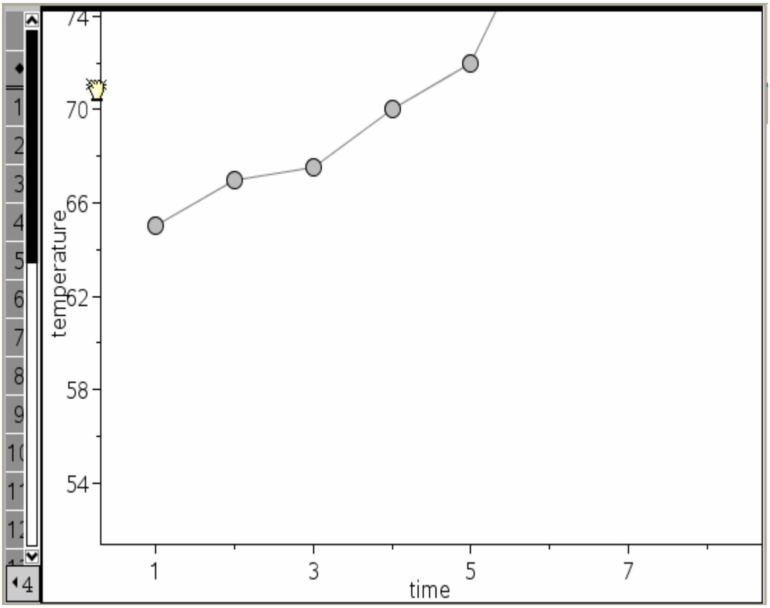
Translation

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 cursor over a tic mark or label. The cursor changes to ✣.



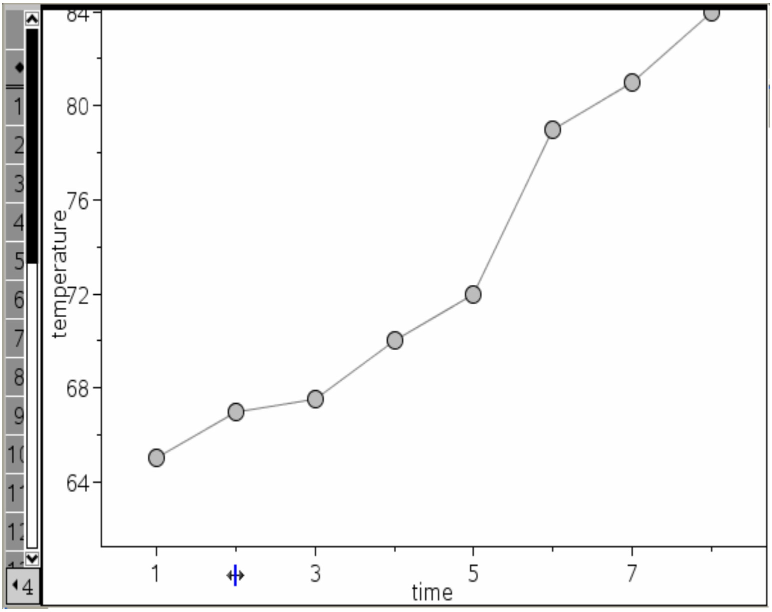
2. Click to grab. The cursor changes to ✋. Drag the cursor to the desired position and release.



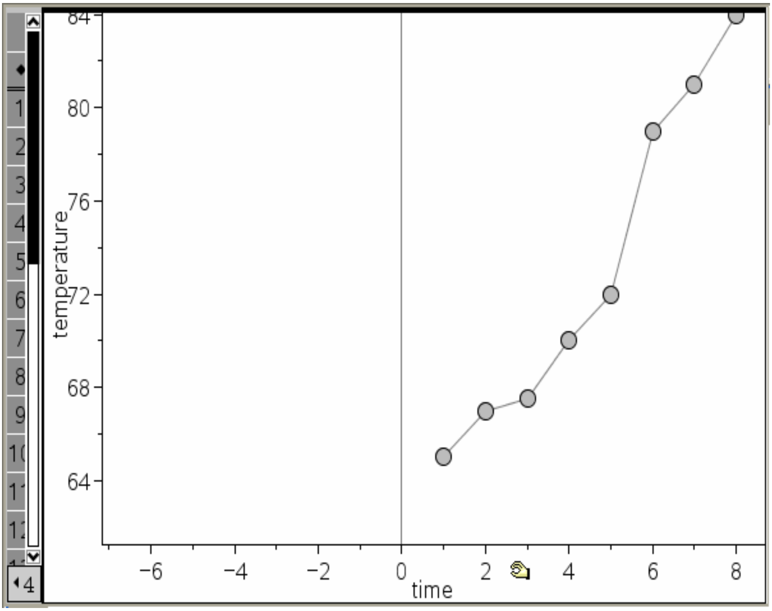
Dilation

Dilation retains the shape of the axes, but the size can be enlarged or reduced.

1. Position the cursor over a tic mark or label. The cursor changes to ‡ on the vertical axis or ⇹ if you are on the horizontal axis.



2. Click to grab. The cursor changes to ☝. Drag the cursor to the desired position and release.



Using Window/Zoom tools

Use the Window/Zoom tools to redefine the graph to better view points of interest. The Window/Zoom tools include:

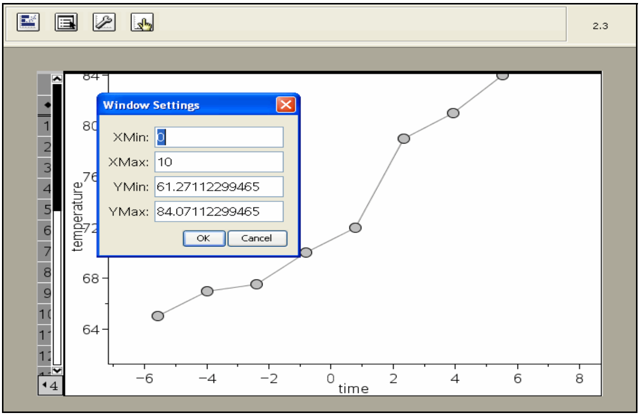
- Window Settings: displays a Window Settings dialog that lets you enter the *x*-min, *x*-max, *y*-min, and *y*-max values for the axes.
- Zoom - Data : adjusts the zoom factor to display all plotted data.
- Zoom - In : lets you to define the center point of the zoom in location. The Zoom In factor is approximately 2.
- Zoom - Out : lets you define the center point of the zoom out location. The Zoom Out factor is approximately 2.

Using Window Settings

1. Click the Window/Zoom tool , and select Window Settings.

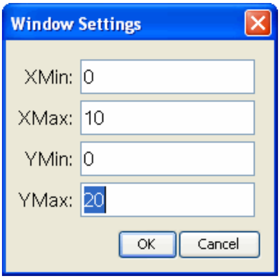
   Press menu 4 1.

2. The Window Settings dialog opens. The current values for *x*-min, *x*-max, *y*-min, and *y*-max display in the fields.

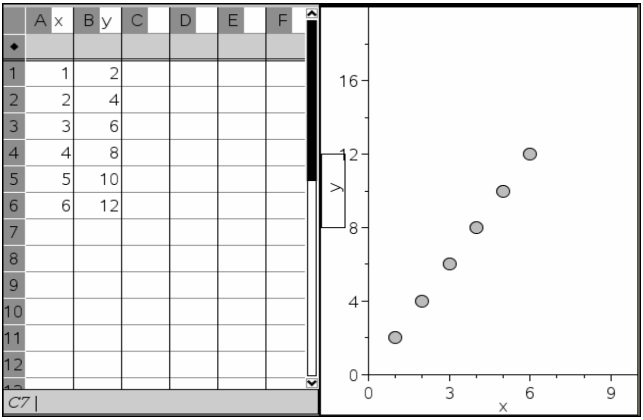


Note: Only the appropriate boxes are editable, depending on whether there are one or two axes in the work area.

3. Type the new values over the old values.



4. Select **OK** to apply the changes and redraw the plot.



Using Zoom Data

1. Click the Window/Zoom tool , and select Zoom Data .

   Press menu 4 1.

2. IThe work area rescales to display all plotted data.

Using Zoom In

1. Click the Window/Zoom tool , and select Zoom In .

   Press menu 4 3.

2. In the work area, click the center point of the area of interest. This will be the center of the zoom in action.

3. The plot redraws to focus and enlarge the portion of the plot centered about the point you selected in the previous step.

Using Zoom Out

1. Click the Window/Zoom tool , and select Zoom Out .

   Press menu 4 4.

2. In the work area, click the center point of the area of interest. This will be the center of the zoom out action.

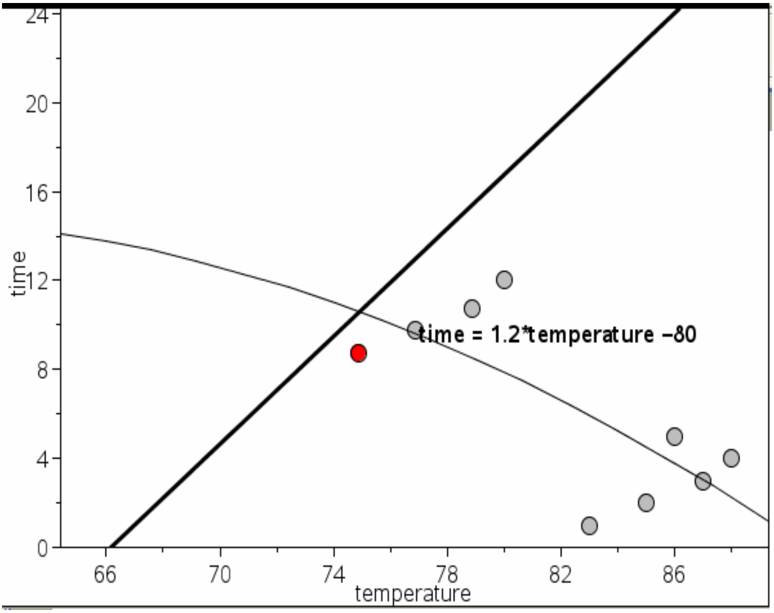
3. The plot redraws to display a larger portion of the plot, centered about the point you selected in the previous step.

Adding a movable line

You can add a movable line to a plot. This line can be moved and rotated on the plot area. The label of the line updates to reflect its position and the model.

▶ Select Add movable line from the Actions menu .

   Press menu 3 2.



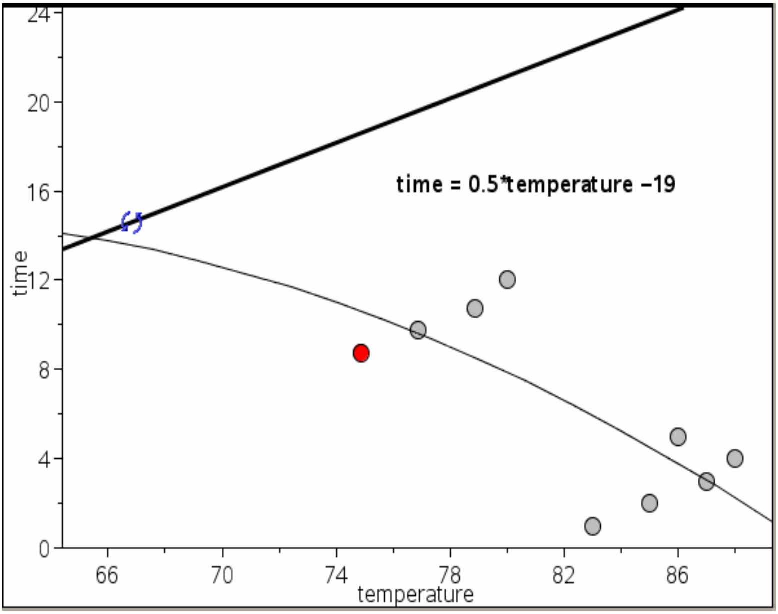
time = 1.2*temperature −80
time
temperature
24
20
16
12
8
4
0
66
70
74
78
82
86

Rotating a movable line

1. Click and grab on either end of the line.

   The cursor changes to ⟲.

2. Drag to rotate and change the slope of the line.

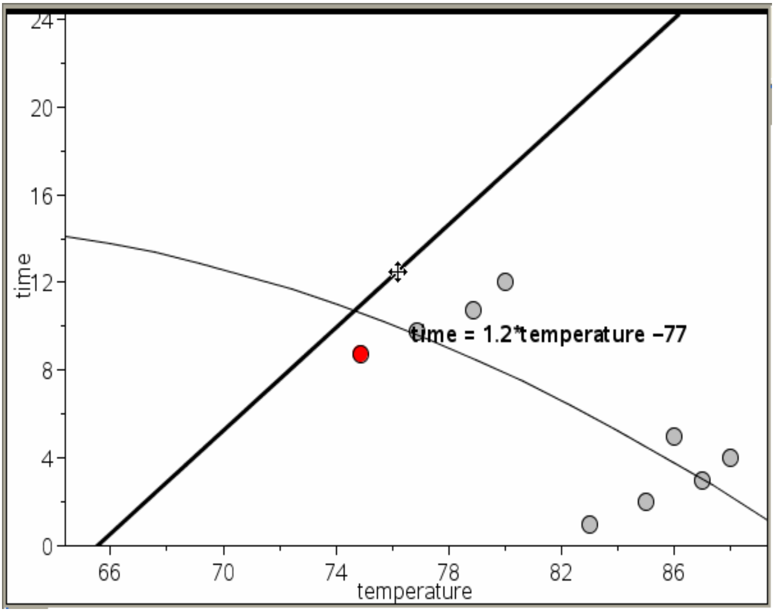


Changing the intercept

1. Click in the middle of the line.

   The cursor changes to ✣.

2. Drag to change the intercept.



Locking intercept at zero

You can lock the intercept of the movable line at zero.

▶ Select Lock intercept at zero  from the Actions menu .

Press (menu) 3 4.

Note: This tool is only available when a regression or movable line is present in the work area.

To unlock the intercept:

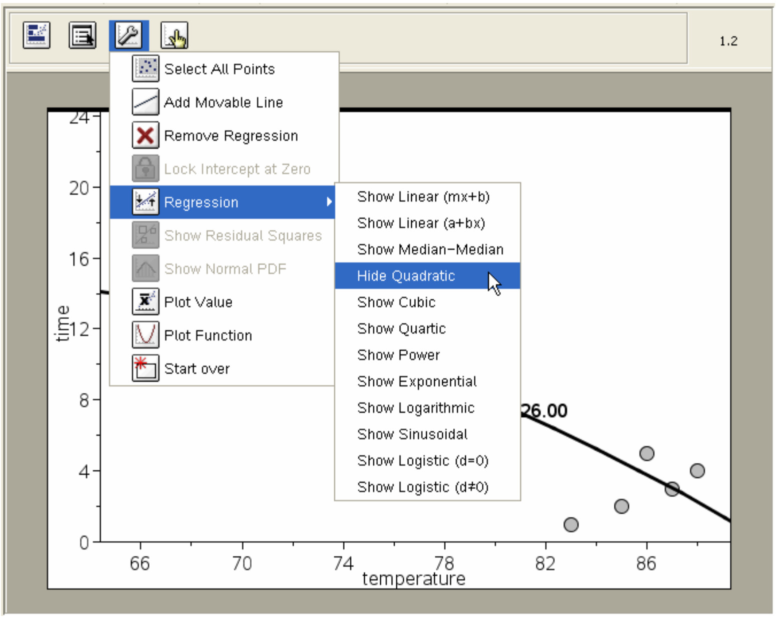
▶ Select Unlock Movable Line Intercept  from the Actions menu .

Press (menu) 3 4.

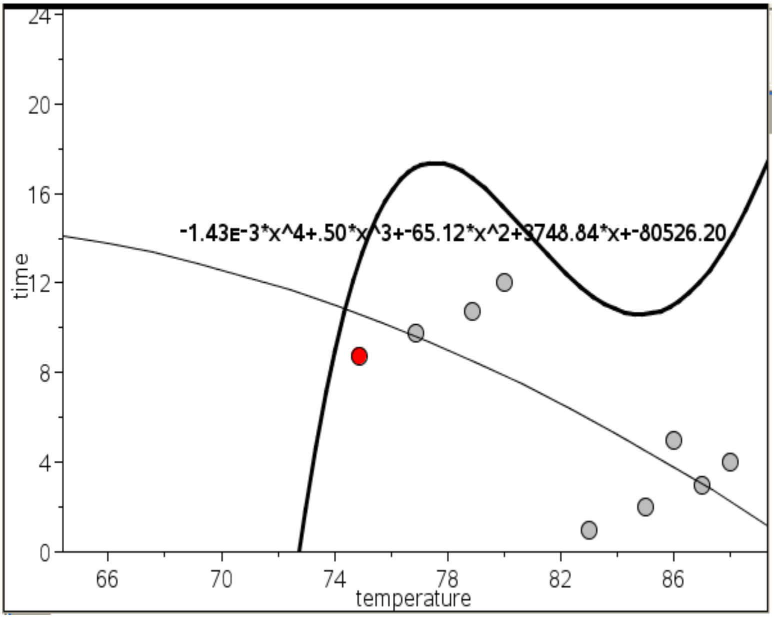
Showing regression lines

▶ Select Regression from the Actions menu , and click to select the regression line you would like to display on the plot.

Press (menu) 3 5 and the number of the regression.



The regression line displays in the work area.



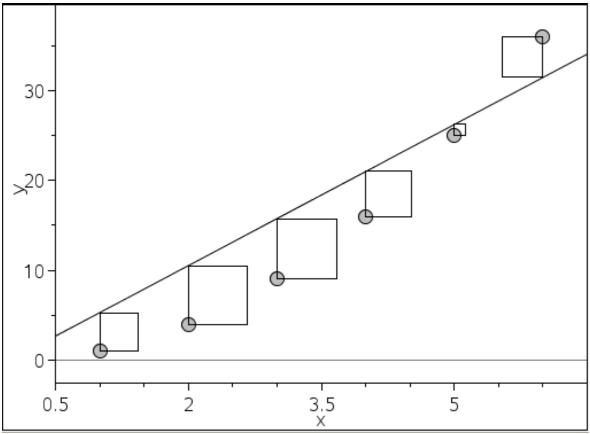
Showing residual squares

You can display residual squares on a plot.

- Select Show Residual Squares from the Actions menu.

  Press menu 3 6.

Note: This tool is only available when a regression or movable line is present in the work area.



Graphing Functions

You can graph functions with Data & Statistics, or you can graph functions from other applications.

To graph a function, enter it in one of the following ways:

- From Data & Statistics: select the Plot Function tool from the Actions menu.

  Press menu 3 9.

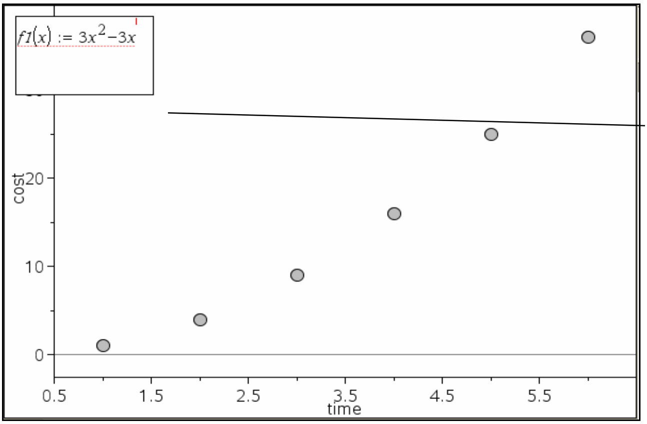
Graphing multiple functions using the Plot Function tool

Use the Plot Function tool to plot multiple functions in the work area. Once plotted, click on the function graph to display the function's equation.

To use the Plot Function tool:

1. Ensure that your work area contains both a horizontal axis and a vertical axis scale.
2. From the Actions menu, select the Plot Function tool.

   Press menu 3 9.
3. A function entry field displays in the work area.



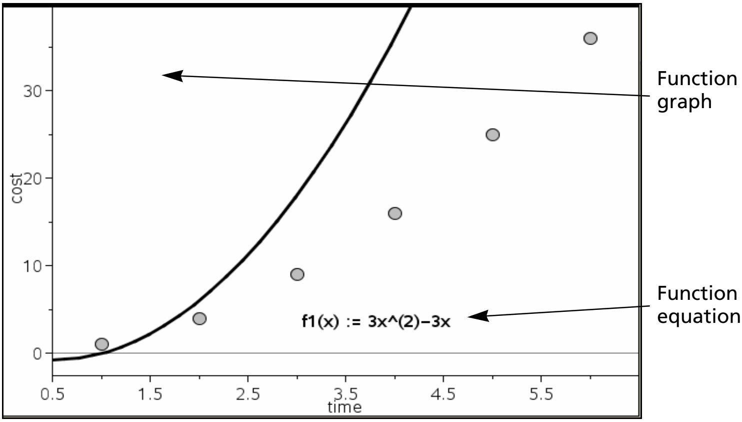
Plot Function entry field

Note: The function graphed in Data & Statistics cannot be manipulated or moved about the work area. To do that, use Graphs & Geometry.

4. 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.

5. The function graphs in the work area.



Entering functions 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. Ensure that your work area contains both a horizontal axis and a vertical axis scale.

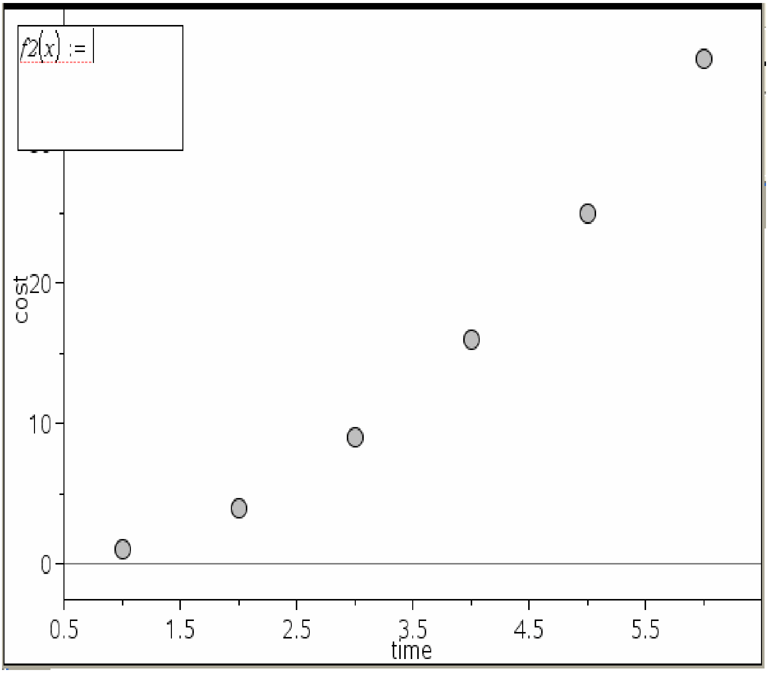
2. From the Actions menu, select the Plot Function tool.

   Press menu 3 9.

   A function entry field displays in the work area.

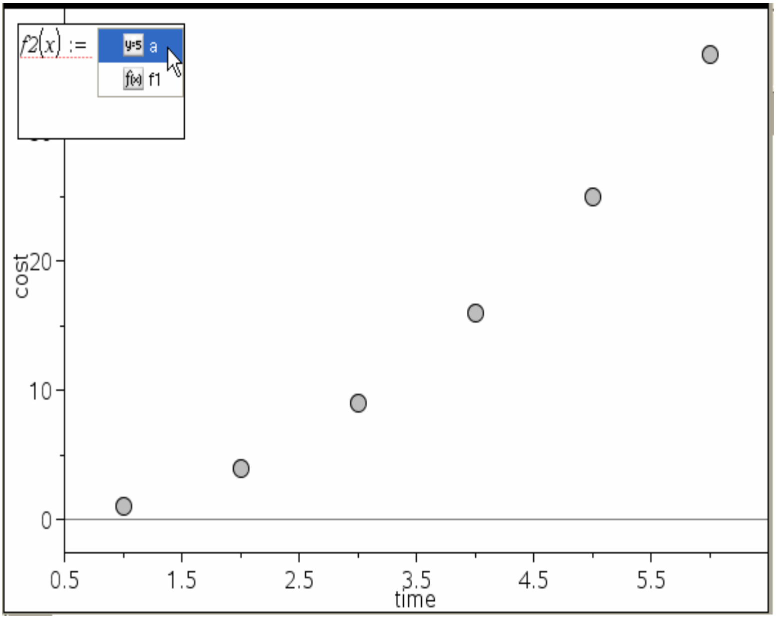
3. Click var on the tool bar to open the Variables menu.

   Press sto▸ var.



A list of variables contained in the problem displays.

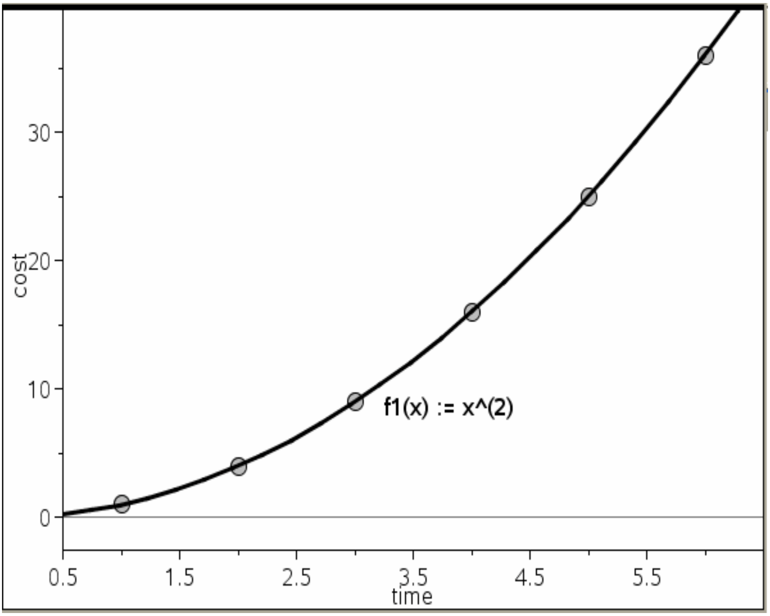
4. Click to select the variable containing the function you want to plot.



In the example below, the variable **a** contains the function **f(x)=x2**.

5. Press Enter.

   The function plots 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.

Note: Function numbers increment by 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).

Supported function types

The following function types are supported in Data and Statistics

- Linear function; f(x)=b
- Linear function; f(x)=ax+b
- Quadratic function; $f(x)=a(x-b)^2+c$
- Exponential function; f(x)=exp(ax+b)+c
- Exponential function; f(x)=b∗exp(ax)+c
- Exponential function; f(x)=d∗exp(ax+b)+c
- Logarithmic function; f(x)=a∗ln(cx+b)+d
- Sinusoidal function; f(x)=a∗sin(cx+b)+d
- Cosinusoidal function; f(x)=a∗cos(cx+b)+d

Using Statistical Tools

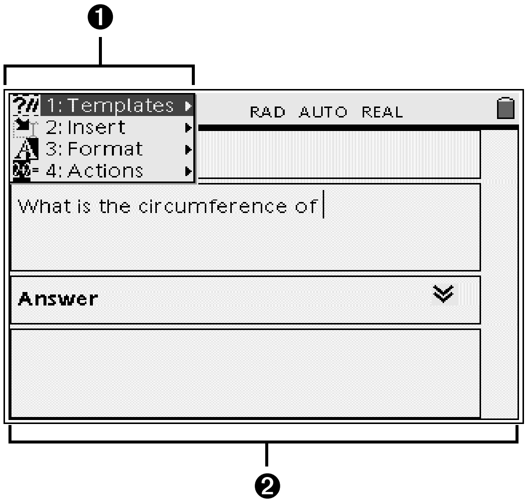
Once you have plotted one or more data sets in Data & Statistics, you can manipulate and explore the data using calculations, data fitting techniques, hypothesis testing tools, and distributions. These functions are available in the Lists & Spreadsheet application. Refer to that chapter for further information.

Using Notes

Getting started with the Notes application

The Notes application provides text editing functions that allow you to create and share documents with others using the TI-Nspire™ handheld and computer software.

You can use the Notes application as a tool to create study notes to reinforce your understanding of classroom concepts and to review for exams. The Notes application allows you to assign different roles to individuals using your document, so that any edits appear in a different text format, making it easy to edit collaboratively.



❶ Notes tool menu – This menu is available anytime you are in the Notes work area. Press (menu) to display the menu.

❷ Notes work area -- The area where you enter and format text.

The Notes tool menu

The Notes tool menu lets you select a Notes template, format text, and evaluate expressions. The table below describes the menu items and their functions.

Menu Name	Menu Option	Function
Templates		
	Q&A	Creates a template to enter question and answer text.
	Proof	Creates a template to enter statement and reason text.
	Default	Lets you enter freeform text.
Insert		
	Expression Box	Lets you insert a math expression.
	Shape	Marks the selected text as an angle, triangle, circle, line, segment, ray, or vector.
	Comment	Lets you enter text that is italicized and prefaced with **Teacher** or **Reviewer**.
Format		
	Keyword	Toggles the selected text between bold and not bold, and removes all other formatting.
	Title	Toggles the selected text between underlined and not underlined, and removes all other formatting.
	Sub-heading	Toggles the selected text between italic and not italic, and removes all other formatting.

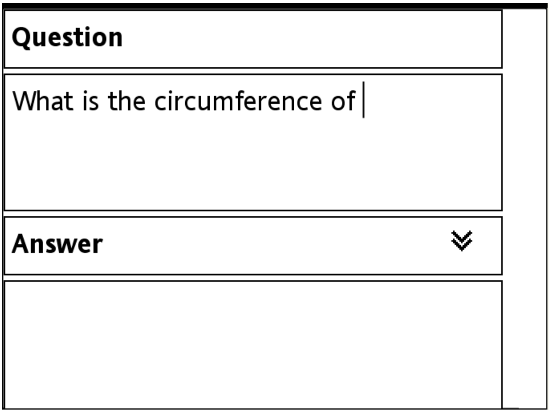
Subscript	Toggles the selected text between subscripted and not subscripted, and removes all other formatting.
Superscript	Toggles the selected text between superscripted and not superscripted, and removes all other formatting.
Actions	
Evaluate selection	Replaces the selected math expression with the result of the expression.
Show or Hide Answer	Shows or hides the answer in a Q&A template.

Before you begin

▶ Turn on the handheld, and add a Notes application to a document.

The Notes work area

The Notes work area is where you enter and format text.



Notes templates

The Notes application provides templates for creating three types of notes:

- **Q&A** for questions and answers, with the answer shown or hidden

- **Proof** for an outline structure containing statements and reasons
- **Default** for open-formatted text entry

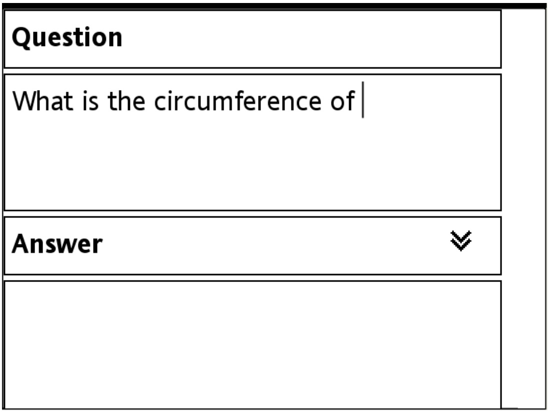
Applying a Notes template

1. While in the Notes work area, press menu to display the Notes menu.
2. On the **Templates** menu, select the specific template to apply.

Using the Q&A Template

Use the Q&A template to create questions and answers. You have the option to 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.

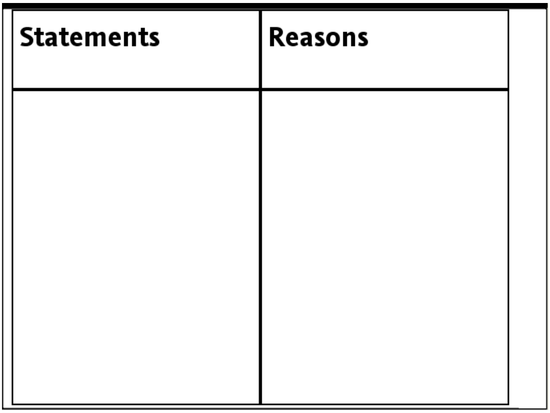
Press tab to move the text cursor between the **Question** and **Answer** areas of the template.



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.

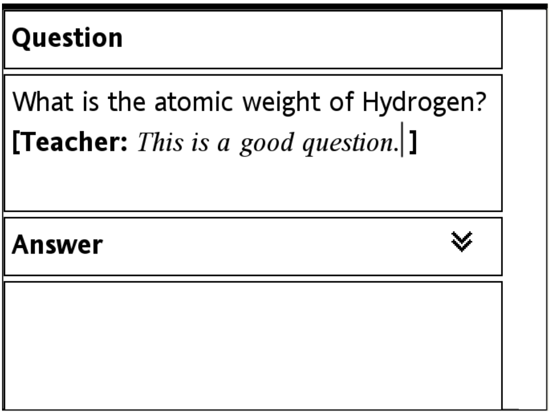


Inserting comments

You can insert Teacher or Reviewer comments into a Notes application. Comments are easily identifiable and easy to distinguish from the original text.

1. While in the Notes work area, press menu to display the Notes menu.
2. On the **Insert** menu, select **Comment**, and then select **Teacher** or **Reviewer**.
3. Enter your text.

   Text that you enter appears in italics.



Formatting Notes text

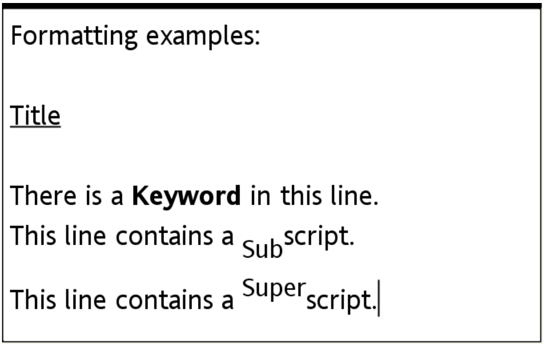
Notes allows you to format text to add context to your documents. Use the tools on the Text options menu to specify text as a keyword, title or subheading, or to format text as subscript or superscript.

Selecting text

1. If you are using the Q&A or Proof template, press tab to place the cursor in the area containing the text.
2. Use the NavPad to place the cursor at the start or end of the text to be selected.
3. Hold down CAPS ⇧, and use the NavPad to select the text.

Applying a text format

1. Select the text in the Notes work area.
2. Press menu to display the Notes menu.
3. On the **Format menu,** select the name of the format to apply.

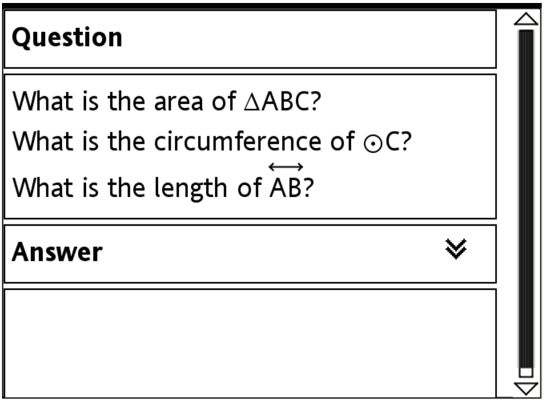


Note: You can restore the text to normal by reapplying the same format.

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.

1. Position the cursor where you want to insert a shape symbol.
2. Press menu to display the Notes menu.
3. On the **Insert** menu, select **Shapes**, and then select the shape to apply.



Entering and evaluating expressions

You can include math expressions in Notes text, using the same tools as in other TI-Nspire™ applications. You can also evaluate an expression and display the result.

Entering an expression

1. In the Notes work area, place the cursor where you want the expression.
2. Press menu to display the Notes menu.
3. On the **Insert** menu, select **Expression Box**.
4. Type the expression. You can use the Catalog, if necessary, to insert a function, command, symbol, or expression template.

Evaluating an expression

Note: The result of the expression will replace the expression. If you need both the expression and its result, make a copy of the expression and then evaluate the copy.

1. Select the entire expression.
2. Press menu to display the Notes menu.
3. On the **Actions** menu, select **Evaluate Expression**.

   The result replaces the expression.

Data Collection

The Data Collection tool enables you to collect experimental information from a sensor and automatically display it in a table and/or graph for analysis. It works with both the Lists & Spreadsheet and Graphs & Geometry applications. Refer to these application chapters to learn more about using both Graphs & Geometry and Lists & Spreadsheet.

Compatible sensors

Data Collection is capable of interacting with the following sensors:

- Vernier EasyTemp®
- Texas Instruments CBR2™ Motion Detector
- Vernier Go!®Temp
- Vernier Go!®Motion

Experimental data

The Data Collection tool collects distance or temperature data points at regular intervals over time. The units of measure, degrees Celsius, seconds, and meters, cannot be changed.

The table below shows the number of samples and sampling interval for the sensors currently supported.

Sensor	**Number of Samples**	**Sampling Interval**	**Test Duration**
Vernier EasyTemp®	180	1 second	180 seconds
Texas Instruments CBR2™ Motion Detector	100	0.05 second	5 seconds
Vernier Go!®Temp	180	1 second	180 seconds
Vernier Go!®Motion	100	0.05 second	5 seconds

Starting the Data Collection tool

The Data Collection tool can be started automatically or manually.

Automatic start mode

An automatic start occurs when a sensor is connected to either a TI-Nspire™ handheld or a computer running TI-Nspire™ computer software. The connected sensor is configured to work with the Data Collection tool in an open Graphs & Geometry page, or if there is no available Graphs & Geometry on the active page, a new page opens and the page displays Graphs & Geometry and Lists & Spreadsheet. If more than one document is open (on a computer), you are asked to select which document to use.

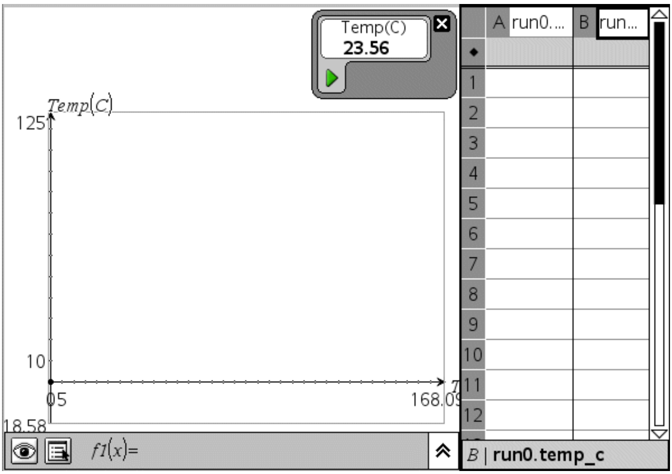
The Data Collection tool:

- determines the type of sensor you have connected.
- labels the Graphs & Geometry axes with the appropriate experiment labels and adds labels to the Lists & Spreadsheet columns if Lists & Spreadsheet is on the same page.

Data Collection is ready to monitor and collect experimental data samples.

The following example shows a Data Collection page ready to collect data. This page contains a default template for collecting EasyTemp experimental data.

Note: The columns were manually widened to show headings.



Data Collection page ready for temperature versus time experiment

Manually starting the Data Collection tool

When you choose to add the Data Collection tool to a Graphs & Geometry application page, it is strongly recommended that you also add Lists & Spreadsheet to the page as well. This is not required, but if you want to store data from multiple experiments, you will need the Lists & Spreadsheet application on the page.

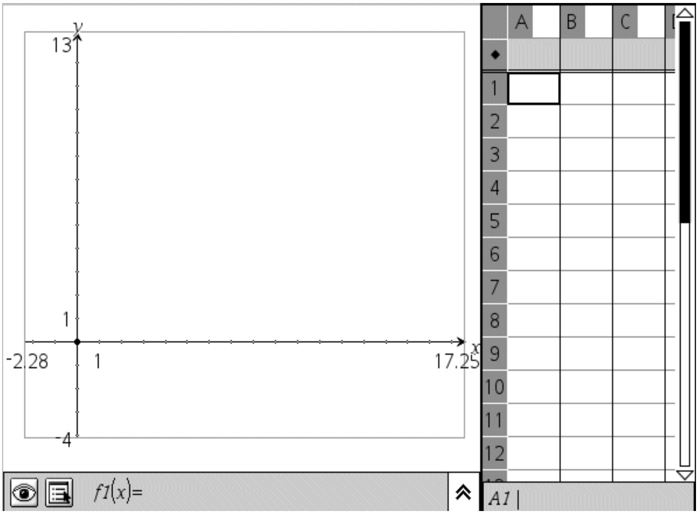
When you add the Data Collection tool, it attempts to configure itself to the first available sensor. Any sensor that is already being controlled by another Data Collection tool is considered unavailable. To make an unavailable sensor available again, close its Data Collection tool.

To set up a page for Data Collection:

1. Add a new page to your current document or open a new document.

   Apply a new page layout template using the Page Layout button to define two work areas.

2. Add Graphs & Geometry to one area of the new page, and add Lists & Spreadsheet to the second area.



3. Add the Data Collection tool to the page containing Graphs & Geometry. To do this, select the Data Collection tool (press: menu 1 9) from the Tools menu.

4. Data Collection scans for an attached sensor. When one is found, Data Collection determines the appropriate labels for Graphs & Geometry axes and adds them to the graph. Graphs & Geometry labels include the numeric ranges on the axes as well as the text labels. The columns in Lists & Spreadsheet are also labeled.

Data Collection controls

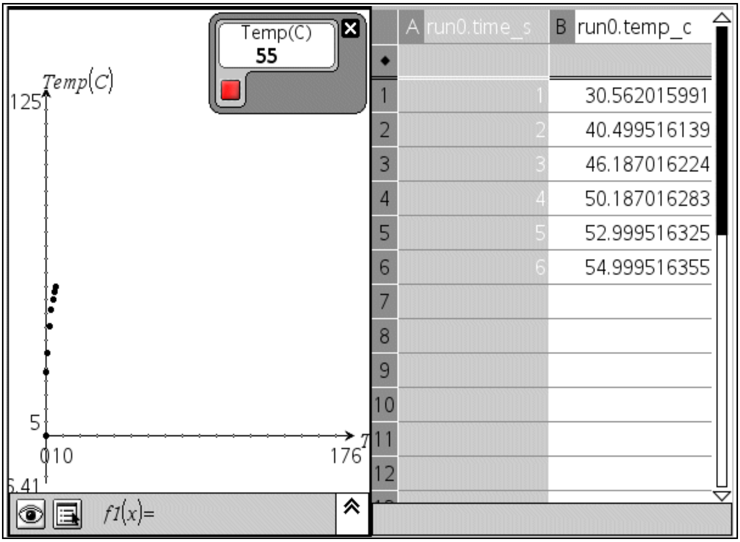
The specific controls available for use with the Data Collection tool are listed in the following table.

Icon	Control Name	Function
	Start Data Collection	Initiates data collection.
	Stop Data Collection	Stops data collection. The graph of existing data points is shown, and for motion experiments, velocity and acceleration data for the points are also available.
	Close	Close button. Completely closes the control box. If this button is selected when data collection is in progress, all data collection stops. The plot is erased. If Lists & Spreadsheet is on the page, the data points collected are shown in the columns. For motion experiments, velocity and acceleration data is not provided.

Running an experiment and collecting data

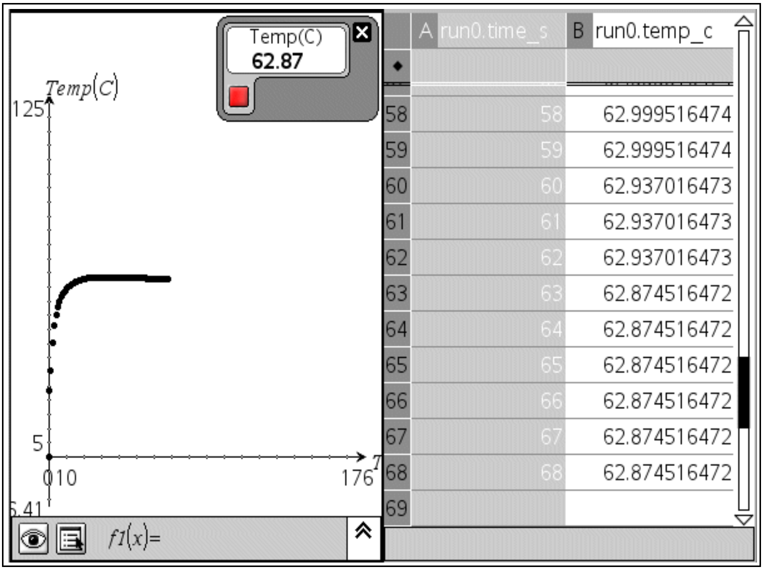
1. When the desired sensor is connected and the Data Collection page is set up as desired, press the Start icon ( ).

2. If Lists & Spreadsheet is on your page, you see each sample collected populate the rows in the table. The sampling data points are plotted on the graph.

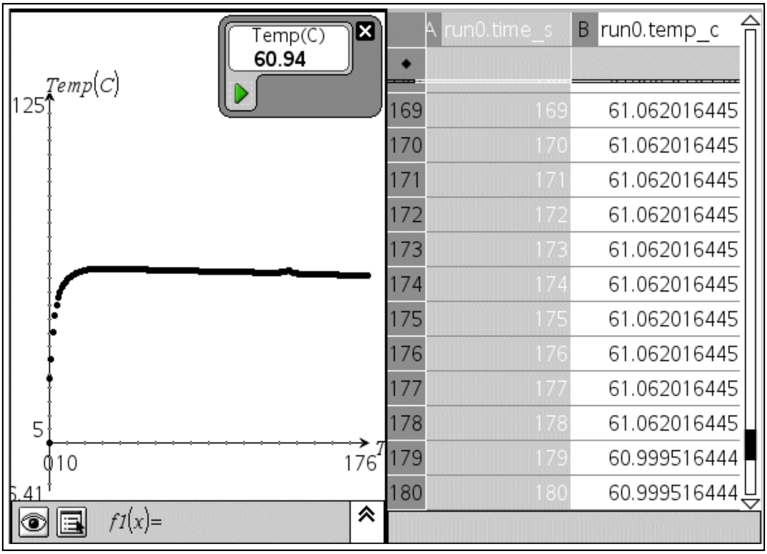


3. The experiment is completed when all data points have been collected. Data Collection automatically stops.

   If desired, you can press Stop ( ) prior to the end of the experiment.



4. The data from this experiment is shown on the Graphs & Geometry plot.



5. To rerun the experiment without retaining the current data, press START (▶). The data displayed is erased when the new experiment is started.

   Note: When you press START, an Overwrite Data message displays, warning you that the existing data will be lost.

   - Select Cancel and read the section entitled "Storing collected data" to save the existing data.
   - Select OK to rerun the experiment and overwrite the existing data.

Data Collection names

The naming system for Data Collection data includes a group designator and a member designator (group.member). For example, in a temperature versus time experiment, the data is named *run0.temp_C* and *run0.time_s*. Remember that TI-Nspire™ computer software is case insensitive: *RUN0.TEMP_C* and *run0.temp_c* reference the same set of data.

Storing collected data

To save the current data before rerunning an experiment, use the following instructions.

To save temperature data

1. Cut and paste each column of data into new columns.

   The first two columns (Columns A and B) will be reused by the next run of the experiment.

2. Rename each moved column.

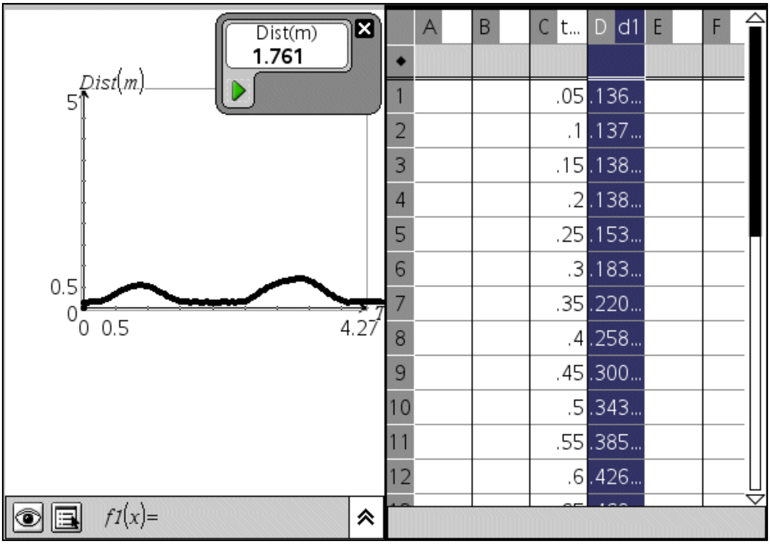
Repeat the steps for each data sample you want to save. To permanently save a set of data generated by an experiment, save the document.

To save motion data

1. Cut and paste each column of data into new columns.

   The first two columns (Columns A and B) will be reused by the next run of the experiment.

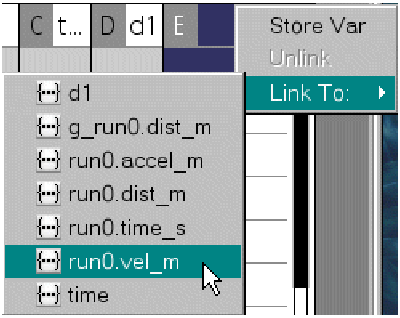
2. Rename each moved column.



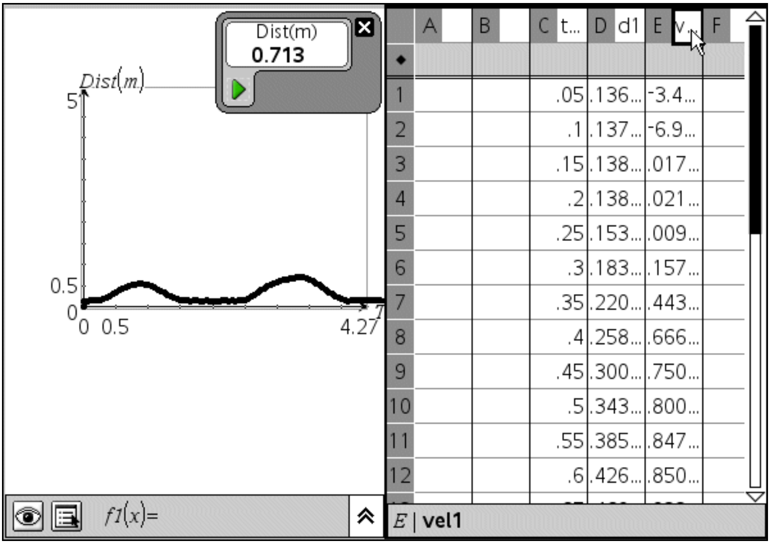
3. To save velocity data, select a third column.

   Highlight the column, and select **var**.

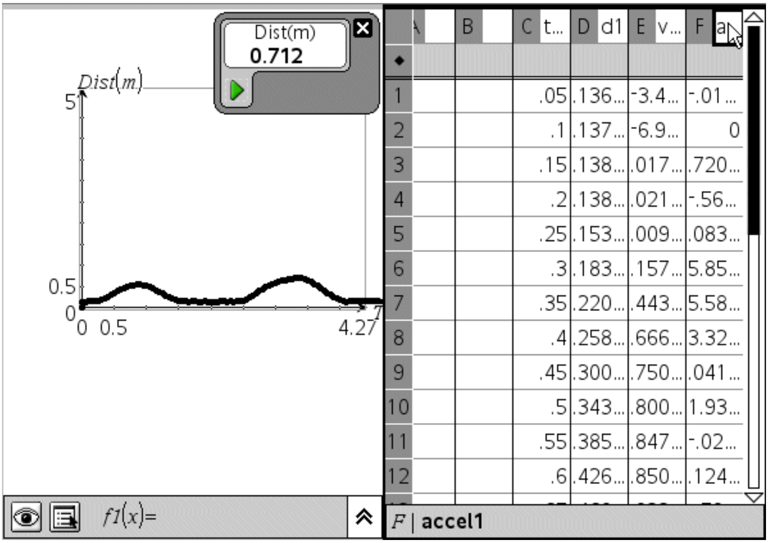
   Select Link to: and choose the velocity variable.



   The column is filled with the velocity values for the experiment. Rename the column with a unique name.



4. Repeat this procedure to save acceleration data.



5. Repeat the steps for each experimental data set you want to save.

   To permanently save all experimental runs retained on the page, save the document.

Retrieving stored experimental results

To review stored experimental data, open the document that contains the data. If necessary, set up and configure Graphs & Geometry and Lists & Spreadsheet. You can perform further data analysis using the Lists & Spreadsheet application.

Troubleshooting the Data Collection tool

Following are some of the most common situations you might experience along with guidelines for correcting them.

Sensor was not detected by TI-Nspire™ software when connected to a TI-Nspire™ handheld or computer.

- Check that the sensor connectors are completely inserted into the handheld/computer.
- Unplug the sensor then reconnect it. This should restart the communication link.

Low batteries.

This message displays when the batteries in your Vernier Go!®Motion or CBR2™ unit are low. Replace the batteries at the next convenient opportunity.

Note: If you connect these sensors to your computer, batteries are not required. The sensors will obtain their power from the computer by way of the USB port.

Bad batteries: *<hardware name>*

This message displays when the batteries in your Vernier Go!®Motion, CBR2™, or TI-Nspire™ handheld are too low to continue data collection. Consult the Battery Information section of this manual or your sensor's manual to replace them.

Communication Failure.

This message displays when communication is disrupted between the TI-Nspire™ handheld or TI-Nspire™ computer software and the connected data collection device. Check all connections and power, then restart the Data Collection tool.

Data Collection Conflict.

This message displays when another computer application is managing data collection. To collect data using TI-Nspire™ computer software, close the other data collection application and restart the TI-Nspire™ software.

Unrecognized Device.

This message displays when you attempt to collect data with Vernier EasyLink® or Vernier Go!® Link and the TI-Nspire™ Data Collection tool. TI-Nspire™ software does not support the use of EasyLink® or Go!® Link at this time.

Overwrite Data.

This message displays when you start a Data Collection experiment and you already have data present from a previous run. To save the existing data, press Cancel. See the Storing Data section of this chapter for detailed instructions on saving different types of data.

Device not found.

The expected data collection device was not found. This message displays when you open a document that had a Data Collection tool open, and either no sensor is connected or the wrong sensor is connected. To correct the error situation, close the document, attach the correct sensor and then reopen the document.

Error.

This message displays when an unexpected error occurs that in some way interferes with the Data Collection tool. Data Collection is terminated. Verify that all connections and batteries are good, then retry the experiment.

Appendix: Service and Support

Texas Instruments Support and Service

For general information

For more information about TI products and services, contact TI by e-mail or visit the TI Internet address.

E-mail inquiries:	ticares@ti.com
Home Page:	education.ti.com

Service and warranty information

For information about the length and terms of the warranty or about product service, refer to the warranty statement enclosed with this product or contact your local Texas Instruments retailer/distributor.

Service

Refer Servicing to Qualified Service Personnel under the Conditions Listed Below:

- If liquid has been spilled or objects have fallen into the product.
- If the product has been exposed to rain or water.
- If the product does not operate normally as per the operating instructions.
- If the product has been dropped or the case has been damaged.

Battery Precautions

Take these precautions when replacing batteries.

- Do not leave batteries within the reach of children.
- Do not mix new and used batteries. Do not mix brands (or types within brands) of batteries.
- Do not mix rechargeable and non-rechargeable batteries.
- Install batteries according to polarity (+ and -) diagrams.
- Do not place non-rechargeable batteries in a battery recharger.
- Properly dispose of used batteries immediately.
- Do not incinerate or dismantle batteries.

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.

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