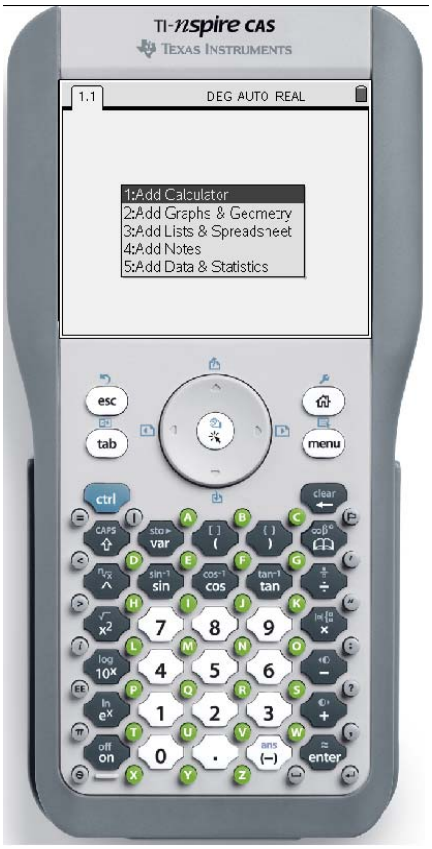
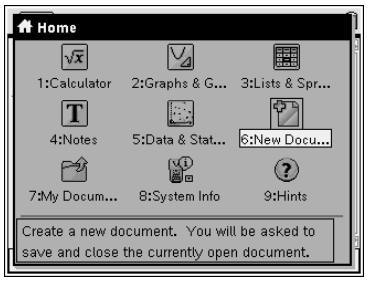
TI-Nspire™ CAS Graphing Calculator

Contents



Visit the *Functions 11* page on the McGraw-Hill Ryerson Web site, at www.mcgrawhill.ca, and follow the links to more resources for the TI-Nspire CAS.

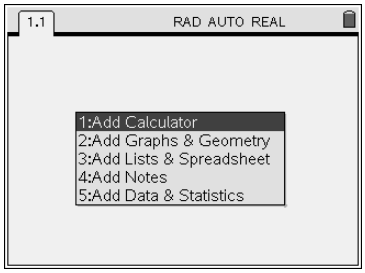
Opening a New Document



• Press the home key, , and select **6:New Document**.

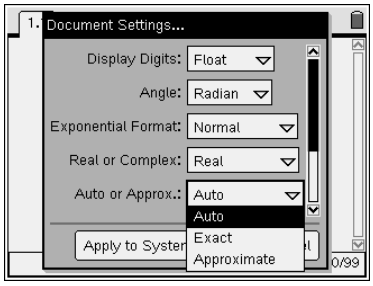
Select the kind of page you want to open. You have several choices.

1:Add Calculator lets you perform calculations.
2:Add Graphs & Geometry lets you plot functions and other graphs, or draw sketches similar to dynamic geometry software.
3:Add Lists & Spreadsheet allows you to work with lists in a spreadsheet environment.
4:Add Notes lets you type notes.
5:Add Data & Statistics lets you work with your lists.



Setting Auto/Approximate Mode

To set the calculator to display approximate decimal answers:



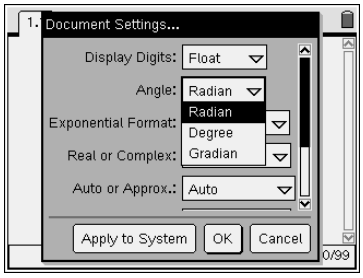
- Press . Select **8:System Info**.
- Select **1:Document Settings…** if you want the changes to apply only to the current document

OR

- Select **2:System Settings...** if you want the changes to apply to all documents that you open.
- Scroll to the **Auto or Approx.** field and set to **Approximate**.
- Scroll to **OK** and click to finish.

Setting Degree Mode

To set the calculator to degree mode:

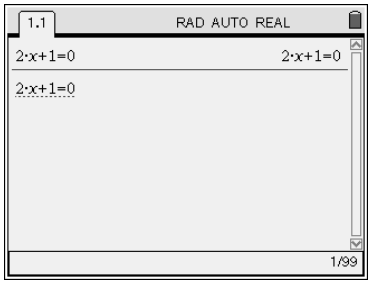


- Press . Select **8:System Info**.
- Select **1:Document Settings…** if you want the changes to apply only to the current document

OR

- Select **2:System Settings...** if you want the changes to apply to all documents that you open.
- Scroll to the **Angle** field, and set it to **Degree**.
- Scroll to **OK** and click to finish.

Copying and Pasting an Expression or Equation



Method 1

- Open a new **Calculator** page.
- Type an expression or equation, and press enter.
- Press the up cursor twice to highlight the expression or equation.
- Press ctrl, then C, to copy the expression or equation.
- Press the down cursor twice to return to the entry line.
- Press ctrl, then V to paste the expression or equation.

The expression or equation will appear in the entry line. You can edit as desired.

Method 2

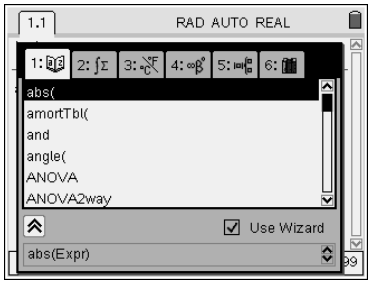
- Open a new **Calculator** page.
- Type an expression or equation, and press enter.
- Press the up cursor twice to highlight the expression or equation.
- Press enter.

The expression or equation will appear in the entry line, along with the cursor. You can edit as desired.

Accessing the Catalogue

- Open a new **Calculator** page.
- Press the Catalogue key, ctrl.
- Press 1 to access the general catalog.
- Press any letter to display entries that begin with that letter. For example, press the letter A.
- Press enter to accept the absolute value function **abs(**.
- Type −5, and press enter.

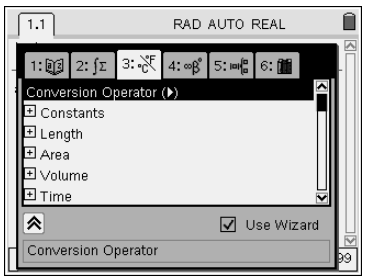
The calculator will display the absolute value of −5.



For a list of units:

- Press ctrl.
- Press 3.

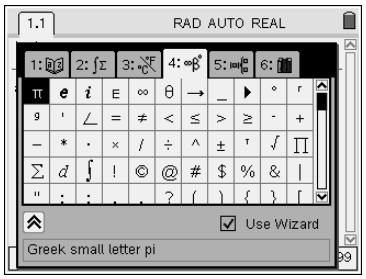
A list of units will appear. You can use this to insert units into your document.



For a table of symbols:

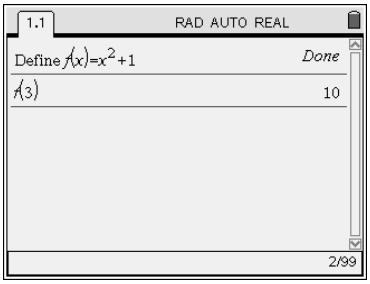
- Press 4.

A table of symbols will appear. You can use this table to insert symbols into your document.



Defining a Function Without Input Values

You can define a function, such as $f(x)$, and then use it in other operations.



- Open a new **Calculator** page.
- Press (menu)**.** Select **1:Actions**, then **1:Define**.
- Type the function $f(x) = x^2 + 1$. Press (enter).

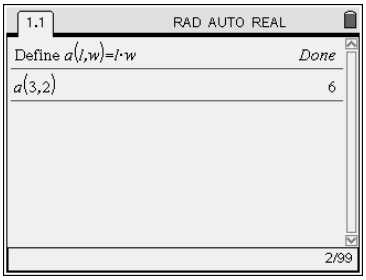
Note the message "*Done*". The function has been stored in memory.

- Type $f(3)$, and press (enter).

The calculator evaluates the function at $x = 3$, and displays the answer, 10.

Defining a Function with Input Values

You can create a function that performs a calculation, such as evaluating a formula.
For example, create a function, a, that calculates the area of a rectangle with length l and width w.



- Open a new **Calculator** page.
- Press (menu). Select **1:Actions**, then **1:Define**.
- Type the function $a(l,w) = l \times w$. Press (enter).

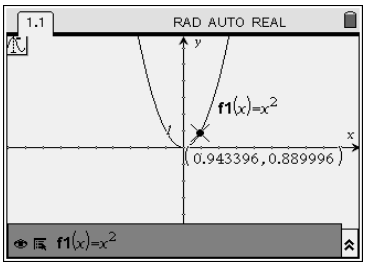
Note: Be sure to include the multiplication operator between l and w.

- Type $a(3,2)$. Press (enter).

The calculator evaluates the area function for a length of 3 units and a width of 2 units, and displays the answer 6 square units.

Tracing a Function

For example, trace the coordinates of points on the graph of $y = x^2$.

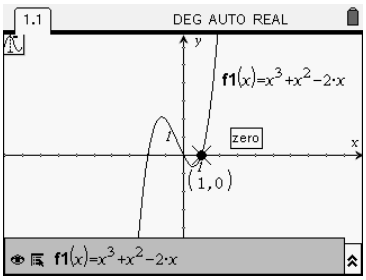


- Open a new **Graphs & Geometry** page.
- Enter x^2 for $f1(x)$.
- Press (menu). Select **5:Trace**, then **1:Graph Trace**.
- Use the cursor to trace along the graph.

The coordinates of the traced point are displayed.

Finding a Zero or Maximum/Minimum Value

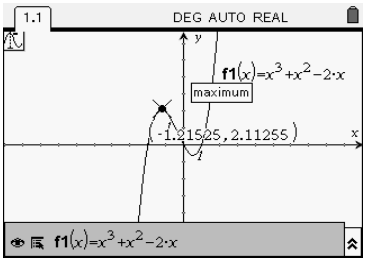
To find a zero, maximum, or minimum value of a function such as $f(x) = x^3 + x^2 - 2x$.



- Open a new **Graphs & Geometry** page.
- Enter $x^3 + x^2 - 2x$ for $f1(x)$.
- Press (menu). Select **5:Trace**, then **1:Graph Trace**.
- Use the cursor to drag the point towards the right-most zero on the graph. When you reach the zero, a box with "zero" will appear, along with the coordinates of the zero.

- Continue dragging the point towards the minimum on the graph. When you reach the minimum, a box with "minimum" will appear, along with the coordinates of the minimum.

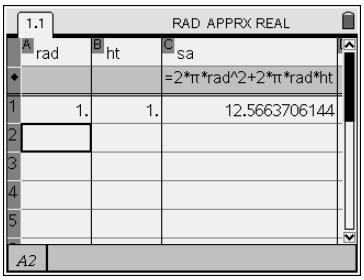
- Continue dragging the point towards the maximum on the graph. When you reach the maximum, a box with "maximum" will appear, along with the coordinates of the maximum.



Using Lists & Spreadsheets

You can create a table of values using a formula. For example, use the formula for the surface area of a cylinder, $SA = 2\pi r^2 + 2\pi rh$.

- Open a new **Lists & Spreadsheet** page.
- Set the calculator to **Approximate** mode. Refer to **Setting Auto/Approximate Mode.**
- Cursor to the top of column A and type "rad" for the radius values.Type "ht" for column B, and "sa" for surface area in column C. Move to the cell below sa and type the formula for the surface area as shown. Be sure to begin with an =.



To resize the columns so that you can see the entire formula:

- Press menu. Select **1:Actions**, then **2:Resize**, and then **1:Resize Column Width**. Use the left and right cursor keys to set the desired width. Press enter and then esc.

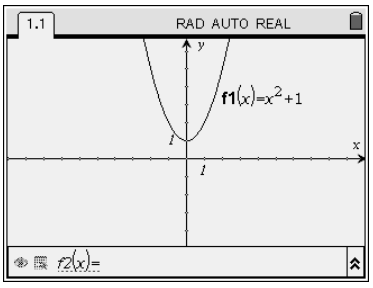
To enter data:

- Move the cursor to cell A1, and type 1.
- Move the cursor to cell B1, and type 1.

The surface area of a cylinder with a radius of 1 unit, and a height of 1 unit, will be displayed. Similarly, you can enter other radii and heights.

Plotting a Function

- Open a new **Graphs & Geometry** page.
- In the entry line, you will see $f1(x) =$. Enter the function and press enter. The example shows $x^2 + 1$.



Note that the function is displayed with its equation as a label. The entry line has moved to function $f2(x)$.
Look at the axes. This is the standard window for the TI-Nspire CAS.

To see, or change, the window settings:

- Press menu. Select **4:Window**, and then **1:Window Settings**.

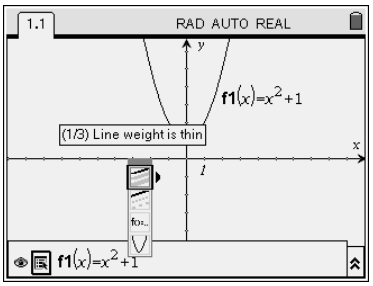
To change the appearance of the window:

- Press menu. Select **2:View**.

There are several options. For example, if you choose option **8:Show Axes End Values**, you can display the current range of each of the axes.

- Press the up cursor once. The function $f1(x)$ will be displayed in the entry line.

To hide or view the graph:



- Press (tab) until the eye symbol, , at the left of the entry line is selected.
- Press (enter) once. Note that the graph is hidden.
- Press (enter) again. The graph reappears.

To adjust the line weight, the line style, the label style, and the line continuity:

- Press (tab) once to select the attributes symbol, , to the right of the eye symbol.
- Press (enter) to display the attributes menu. Use the up/down cursor to select the attribute, and then the left/right cursor to change the attribute.
- When you are finished, press (esc) to return to the graph screen.

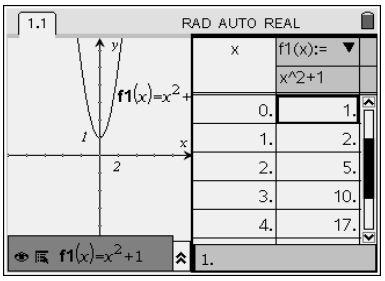
To move a function label around the screen:

- Press (tab) once. The entry line will grey out, and the cursor will move to the graphing window.
- Move the cursor over the function label. When you are in the right place, the word "label" will appear, along with a hand symbol.
- Press (ctrl), then (·) . The hand will close to grab the label. Use the cursor to move the label.
- When you are finished, press (esc).

To move an entire graph:

- Move the cursor to a blank space in the second quadrant.
- Press (ctrl), then (·). A hand will appear.
- Use the cursor to move the hand around. Notice how the hand grabs the entire graph.
- When you are finished, press (esc).
- Press (tab) once to return to the entry line. Press the up cursor once to return to the function *f1*(*x*).

To display a table of values for the function:

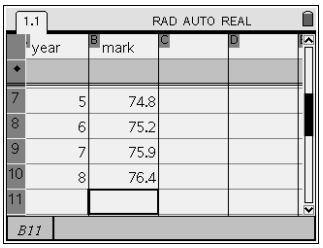


- Press (menu), and select **2:View**.
- Select **9:Add Function Table**. You can scroll up and down to inspect different values.
- Press (menu). Select **5:Function Table**, then **3:Edit Function Table Settings**. You can adjust the table start value, and the table step value.

Drawing a Scatter Plot

The average annual mark on a standardized test is shown for several years. Create a scatter plot for these data.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
Mark	71.2	72.3	73.1	73.9	74.6	74.8	75.2	75.9	76.4

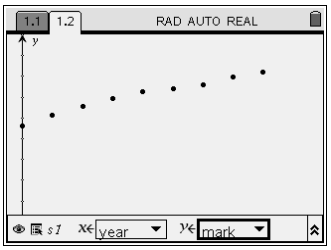


- Open a **Lists & Spreadsheet** page.
- Enter the headings and data in the columns.

Note that 1998 is recorded as year 0.

- Open a new **Graphs & Geometry** page.
- Press (menu)**.** Change the graph type to **Scatter Plot**.
  Select **year** from the *x*-axis dropdown menu.
  Select **mark** from the *y*-axis dropdown menu.
- Press the (menu) button. Adjust the **Window** settings from –0.5 to 10.0 for the *x*-axis, and from 60 to 80 for the *y*-axis.

Your scatter plot will appear as shown.



Linear Regression and Graphing

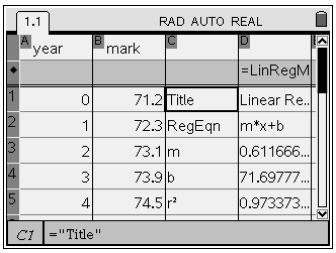
Use the year and mark data from **Drawing a Scatter Plot**.

- Return to the **Lists and Spreadsheet** page.
- Press (menu). Select **6: Statistics**, and then, **1: Stat Calculations.**
- Select **3: Linear Regression (mx + b)**.

Select **year** for the **X List,** and **mark** for the **Y List**.

- Tab down and select **OK**.

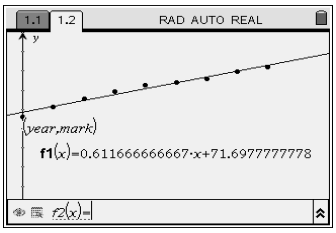
The linear equation of best fit will be displayed: $y = 0.61x + 71.7$.



To graph the line of best fit:

- Press (ctrl) and the right cursor to return to the **Graphs & Geometry** page.
- Set the graph type back to **1: Function**.
- Press (tab).

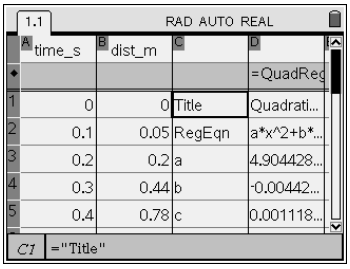
The line of best fit will be displayed.



Quadratic Regression

The distance fallen by a skydiver with respect to time is shown in the table. Determine a quadratic equation that models these data.

Time (s)	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Distance (m)	0.00	0.05	0.20	0.44	0.78	1.23	1.76	2.40	3.14	3.97	4.90



- Open a **Lists & Spreadsheet** page.
- Enter the time and distance data from the table.
- Press (menu). Select **6: Statistics**, and then, **1: Stat Calculations.**
- Select **6: Quadratic Regression**. Select time for the **X List,** and distance for the **Y List**.
- Tab down and select **OK**.

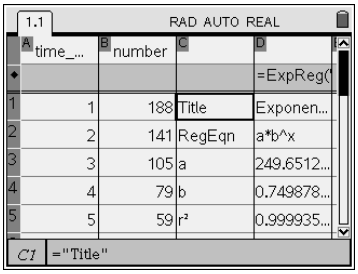
The quadratic equation of best fit will be displayed:

$y = 4.9044x^2 - 0.0044x + 0.0011$.

Exponential Regression

The average wait time for customers at a grocery checkout, is shown in the table. Determine an exponential model for these data..

Time (min)	1	2	3	4	5	6	7	8	9	10
Number of Customers	188	141	105	79	59	44	33	25	19	14

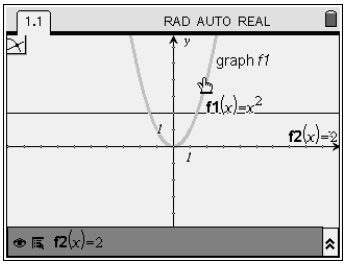


- Open a **Lists & Spreadsheet** page. Enter the headings and data.
- Press (menu). Select **6: Statistics**, and then, **1: Stat Calculations.**
- Select **A: Exponential Regression**. Select time for the **X List,** and number for the **Y List**.
- Tab down and select **OK**.

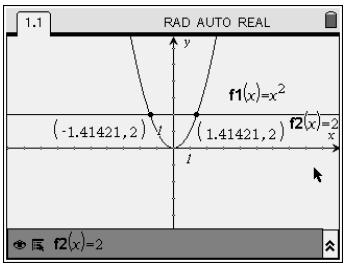
The exponential equation of best fit will be displayed: $y = 249.65x^{0.75}$.

Determine Points of Intersection

To determine where the line $y = 2$ intersects the graph of $y = x^2$:



- Open a new **Graphs & Geometry** page.
- In the entry line, type x^2 for $f1(x)$. Press (enter).
- Type 2 for $f2(x)$. Press (enter).
- Press (menu). Select **6:Points & Lines**, then **3:Intersection Point(s)**.
- Move the cursor until it is over the graph of the first function. Press (enter).



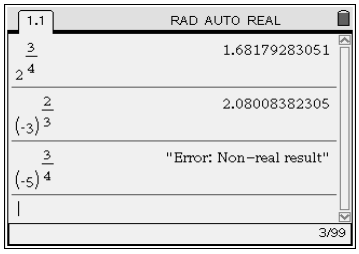
- Move the cursor until it is over the graph of the second function. Press (enter).

The intersection points will be displayed, along with their coordinates.

Evaluating Expressions with Rational Exponents

For example, evaluate **a)** $2^{\frac{3}{4}}$ **b)** $(-3)^{\frac{2}{3}}$ **c)** $(-5)^{\frac{3}{4}}$

- Open a **Calculator** page.
  a) Type 2 ^ (3 ÷ 4 ctrl enter.



Note: Pressing ctrl, then enter makes the calculator display the result as an approximation. Alternatively, you can set the mode to approximation. Refer to **Setting Auto/Approximate Mode**.

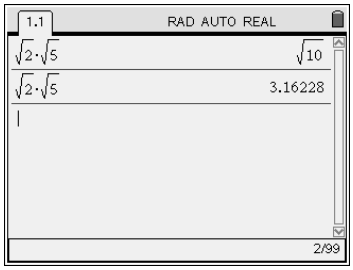
  b) Type (– 3 right cursor ^ (2 ÷ 3 ctrl enter.
  c) Type (– 5 right cursor ^ (3 ÷ 4 ctrl enter.

Note that the last calculation returns an error message. You cannot evaluate an even root of a negative number.

Working With Radicals

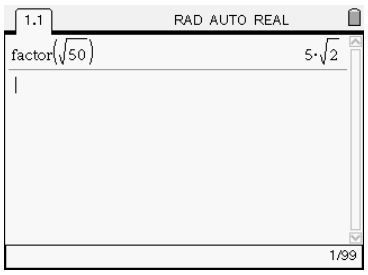
To find the product $\sqrt{2} \times \sqrt{5}$:

- Press home. Select **8: System Info**.
- Select **2: System Settings...** . Use tab to scroll down to **Auto or Approx** and ensure that it is set to **Auto**. Continue down to **OK**, and press enter twice.
- Press home, and select **6:New Document**. Select **1:Add Calculator**.
- Press ctrl and x^2 to enter the square root symbol. Then press 2, and right cursor.
- Press × and enter $\sqrt{5}$.
- Press enter.
- To obtain an approximate answer, press ctrl, and then enter.



To change an entire radical, such as $\sqrt{50}$, to a mixed radical:

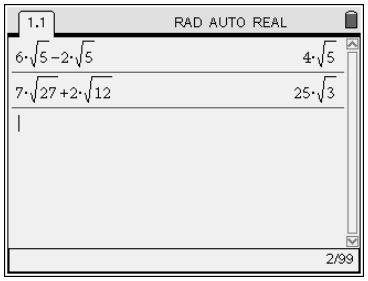
- Press home. Select **1: Add Calculator**.
- Press menu. Select **3:Algebra**. Select **2:Factor**.
- Type $\sqrt{50}$, and press enter.



You can check addition or subtraction of radicals:

- Enter $6\sqrt{5} - 2\sqrt{5}$, and press enter.

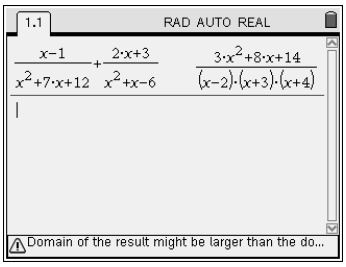
- Try a more complex operation. Enter $7\sqrt{27} + 2\sqrt{12}$, and press enter.



Adding Rational Expressions

You can use a Computer Algebra System (CAS) to add rational expressions, such as $\frac{x-1}{x^2+7x+12}+\frac{2x+3}{x^2+x-6}$.

- Press [home]. Select **6:New Document**.
- Select **1:Add Calculator**.
- Type the expressions:
  (x – 1 **right cursor** ÷ (x ^ 2 + 7 x + 12 **right cursor** + (2 x + 3 **right cursor** ÷ (x ^ 2 + x – 6 **right cursor** [enter].



The sum of the expressions will be displayed.

Calculating First and Second Differences

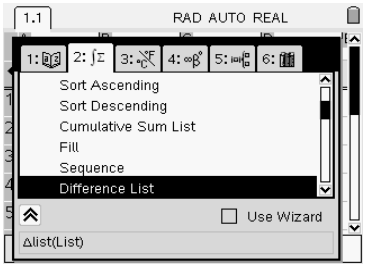
Find the first and second differences for the data shown in the table:

Number	Cost ($)
1	2
2	5
3	10
4	17

- Open a new **Lists & Spreadsheet** page.
- At the top of column A, type the title “number”.
- At the top of column B, type the title “cost”.
- Enter the data.

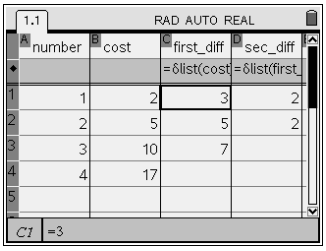
To find the first differences:

- At the top of column C, type the title “first_diff”.
- In the formula cell for column C type =.
- Press the [menu] key, and select tab 2. Scroll down to **List**, and press [enter]. Continue scrolling to **Operations**, and press [enter].
- Scroll down to **Difference List**, and press [enter]. Type “cost” between the brackets, and press [enter].



To find the second differences:

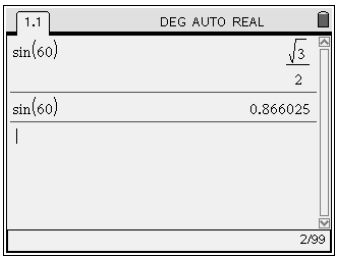
- At the top of column D, type the title “sec_diff”.
- In the formula cell for column D type =.
- Press the [menu] key, and select tab 2. Scroll down to **List**, and press [enter]. Continue scrolling to **Operations**, and press [enter].
- Scroll down to **Difference List**, and press [enter]. Type “first_diff” between the brackets, and press [enter].



Calculating Exact and Approximate Values for Trigonometric Ratios

A computer algebra system (CAS) can display either exact or approximate values for trigonometric ratios of special angles.

- Ensure that the **angle mode** is set to degree, and the **auto/approx mode** is set to auto.
- Press [home]. Select **6:New Document**.
- Select **1:Add Calculator**.
- Type sin(60), and press [enter].



Note that the exact value is displayed.

To display an approximate value:

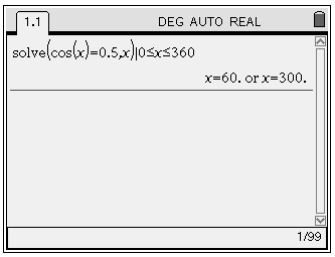
- Press [ctrl] before pressing [enter].

Determining Exact Solutions for Trigonometric Problems

You can use a Computer Algebra System (CAS) to solve trigonometric equations.

For example, determine all angles between 0° and 360° that have a cosine of 0.5.

- Ensure that the **angle mode** is set to degree, and the **auto/approx mode** is set to auto.
- Press [home]. Select **6:New Document**.
- Select **1:Add Calculator**.
- Press [menu]. Select **3: Algebra.**
- Select **1: Solve.**
- Type cos(x) = 0.5, x)|0 ≤ x ≤ 360. To obtain the ≤ sign, press [ctrl] and then, the grey < key.
- Press [enter]**.**



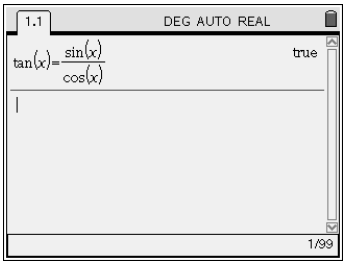
Using a Computer Algebra System (CAS) to Check an Identity

You can use a Computer Algebra System (CAS) to check whether a trigonometric equation is an identity.

For example, check whether $\tan(x) = \frac{\sin(x)}{\cos(x)}$ is true for all values of x.

- Press [home] . Select **6:New Document**.
- Select **1:Add Calculator**.
- Type tan(*x*) = sin(*x*) ÷ cos(*x*), and press [enter].

Note that the CAS returns a value of **true**. This means that the equation is true for all values of *x*.

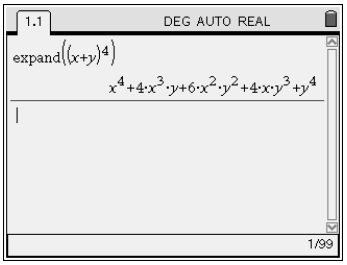


Using a Computer Algebra System (CAS) to Expand a Binomial Power

You can use a Computer Algebra System (CAS) to expand a binomial power.

For example, to expand $(x + y)^4$:

- Press [home] . Select **6:New Document**.
- Select **1:Add Calculator**.
- Press [menu], then **3:Algebra**, then **3:Expand**.
- Type (x + y **right cursor** ^ 4, and press [enter].

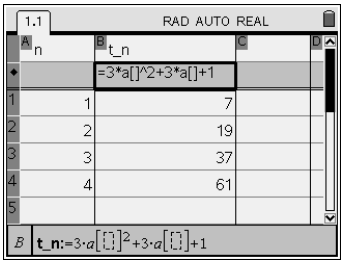


Generating a Sequence

You can generate a sequence of numbers using a **Lists & Spreadsheet** page.

For example, to determine the first four terms of the sequence with general term $t_n = 3n^2 + 3n + 1$.

- Press ⌂. Select **6:New Document**.
- Select **3:Lists & Spreadsheet**.
- At the top of column A, type the title "n".
- At the top of column B, type the title "t_n".
- Enter the values 1, 2, 3 and 4 for *n*, starting in cell A1.
- In the formula cell for column B type
  = 3 × a x^2 + 3 × a + 1, and press enter.

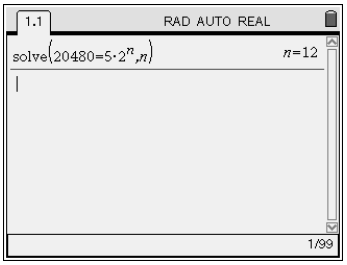


Using a Computer Algebra System (CAS) to Solve an Exponential Equation

You can use a Computer Algebra System (CAS) to solve for the exponent in an exponential equation.
For example, determine the value of *n* that satisfies the equation 20 480 = $5(2)^n$.

- Press ⌂. Select **6:New Document**.
- Select **1:Add Calculator**.
- Press menu, then **3:Algebra**, then **1:Solve**.
- Type 20480 = 5 × 2 ^ *n* **down cursor** , *n* and press **enter**.

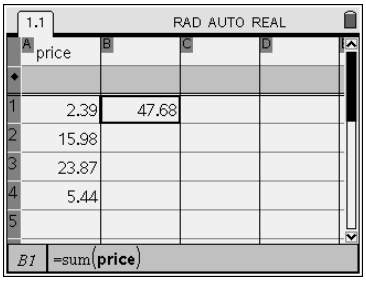
The value of *n* will be displayed.



Using a Computer Algebra System (CAS) to Calculate the Sum of a List

You can use a Computer Algebra System (CAS) to calculate the sum of a list of numbers.
For example, you can calculate the total of a list of prices.

- Press the ⌂. Select **6:New Document**.
- Select **3:Lists&Spreadsheet**.
- At the top of column A, type the title "price".
- Enter prices in column A, as shown.
- Move to cell B1 and type =.
- Press ctrl and select tab 2.
- Scroll down to **List**, and press enter.
- Scroll down to **Math**, and press enter.
- Scroll down to **Sum of Elements**, and press enter.
- Type "price" between the brackets.
- Press enter.



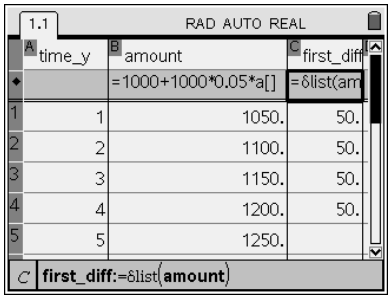
The sum of the items in the price list will be displayed in cell B1.

Alternatively, you can type =sum(price) in cell B1, and press enter.

Constructing a Simple Interest Table Using Lists & Spreadsheet

You can set up a table to calculate an amount with simple interest, and the interest.

- Open a new **Lists&Spreadsheet** page.
- At the top of column A, type the title "time_y". Type the title for column B as "amount", and the title for column C as "first_diff".
- Enter time in column A, as shown.
- Move to the formula cell for column B and type = 1000 + 1000×0.05×A.
- In the formula cell for column C type =.
- Press ctrl, and select tab 2.
- Scroll down to **List**, and press enter. Continue scrolling to **Operations**, and press enter.
- Scroll down to **Difference List**, and press enter.
- Type "amount" between the brackets, and press enter.

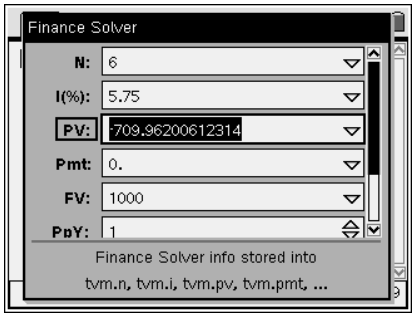


The amounts and first differences, which is the interest for that year, will be displayed.

Finance Solver: Present Value

How much must you invest today to have $1000 in 6 years if interest is 5.75% per year, compounded quarterly?

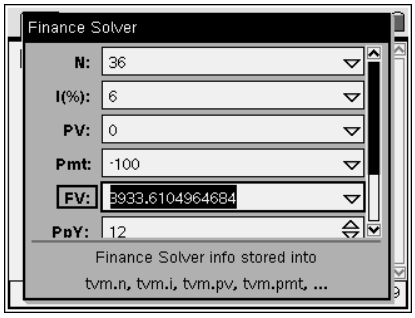
- Open a new Calculator page.
- Press menu. Select **8: Finance**, and then **1:Finance Solver**.
- Enter the known values.
  The term is 6 years, so **N** = 6.
  The annual interest rate is 5.75%, so **I(%)** = 5.75.
  PV is the amount to be determined, so set **PV** = 0 for now.
  There are no payments after the initial investment, so **Pmt** = 0.
  The amount desired after 6 years is $1000, so **FV** = 1000.
  One payment is made, so **PpY** = 1.
  Interest is compounded quarterly, so **CpY**=4.
  Payments are made at the end of the month, so choose END for **PmtAt**.
- Press tab until you return to **PV**.
- Press enter.



You need to invest $709.96.

Finance Solver: Amount of an Annuity
Suppose you deposit $100 into an account that pays 6% per year, compounded monthly, for 3 years. Determine the amount in the account after three years.

- Open a new **Calculator** page.
- Press (menu). Select **8: Finance**, and then **1:Finance Solver**.
- Enter the known values.
  You will make 3×12 = 36 payments, so **N** = 36.
  The annual interest rate is 6%, so **I(%)** = 6.
  PV is the amount before any payments are made, so **PV** = 0.
  The monthly payment is $100, so **Pmt** = −100.
  The future value of the payments is the amount, so set **FV** = 0 for now.
  The payments are made monthly, so **PpY** = 12.
  Interest is compounded monthly, so **CpY** = 12.
  Payments are made at the end of the month, so choose END for **PmtAt**.

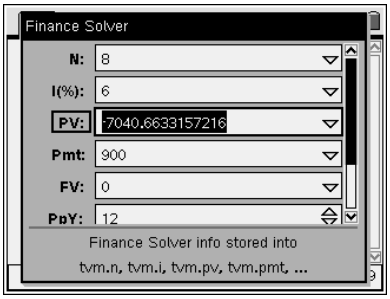


- Press (tab) until you return to **FV**.
- Press (enter).

The amount in the account will be $3933.61.

Finance Solver: Present Value of an Annuity
How much do you need invest now, to withdraw $900 per month for 8 months, if interest is earned at a rate of 6%, compounded monthly?

- Open a new **Calculator** page.
- Press (menu). Select **8: Finance**, and then **1:Finance Solver**.
- Enter the known values.
  You will make 8 withdrawals, so **N** = 8.
  The annual interest rate is 6%, so **I(%)** = 6.
  PV is the amount to be determined, so set **PV** = 0 for now.
  The monthly withdrawal is $900, so **Pmt** = 900.
  The future value of the account is $0, so set **FV** = 0.
  The withdrawals are made monthly, so **PpY** = 12.
  Interest is compounded monthly, so **CpY** = 12.
  Withdrawals are made at the end of the month, so choose END for **PmtAt**.

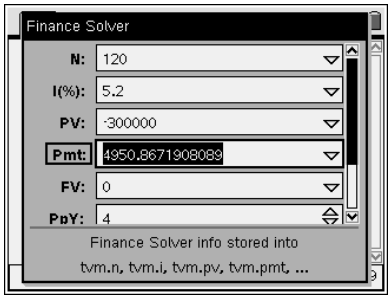


- Press (tab) until you return to **PV**.
- Press (enter).

The amount that you must deposit now is $7040.66.

Finance Solver: Regular Withdrawal from an Annuity

Suppose your life savings total $300 000 when you decide to retire. You plan an annuity that will pay quarterly for the next 30 years. If the account earns 5.2% annual interest, compounded quarterly, how much can you withdraw each quarter?



- Open a new **Calculator** page.
- Press (menu). Select **8: Finance**, and then **1:Finance Solver**.
- Enter the known values.
  You will make 4×30 = 120 withdrawals, so **N** = 120.
  The annual interest rate is 5.2%, so **I(%)** = 5.2.
  Your savings are $300 000, so **PV** = 300 000.
  The quarterly withdrawal is to be determined, so set **Pmt** = 0 for now.
  The future value of the account is $0, so set **FV** = 0.
  The withdrawals are made quarterly, so **PpY** = 4.
  Interest is compounded quarterly, so **CpY** = 4.
  Withdrawals are made at the end of the quarter, so choose END for **PmtAt**.
- Press (tab) until you return to **Pmt**.
- Press (enter).

You can withdraw $4950.87 each quarter.

Shortcut Key Sequences

Many of the shortcut key sequences that work in Microsoft Windows® also work on the TI-Nspire CAS.

Some commonly used shortcut key sequences are:

(ctrl) C: copy
(ctrl) V: paste
(ctrl) X: cut
(ctrl) Z: undo
(ctrl) Y: redo
(ctrl) I: insert page
(ctrl) G: hide or show entry line

Visit the *Functions 11* page on the McGraw-Hill Ryerson Web site and follow the links to see a complete listing of shortcuts.