Welcome to Kalkulator

Welcome to Kalkulator!   I hope you will like the program and find it useful. Please let me know what you like and dislike about it, so that I can keep improving it.

Kalkulator is shareware: have a look at the Registration and Support page. Then start from What Does Kalkulator Do and Evaluating Expressions.

In most situations pressing the F1 key will bring this help. Use it; it should answer most of your questions.

If you are not a heavy scientific and engineering math user, do not feel intimidated by the more advanced capabilities of the program. The features you do not use will not get into your way; just forget about them and use only those you need. After one hour with Kalkulator you will feel at home.

If, after that, you still feel Kalkulator is more than you need, try out its offspring: the Mighty Midget – it is smaller and simpler, yet quite smart; the chances are you may like it.
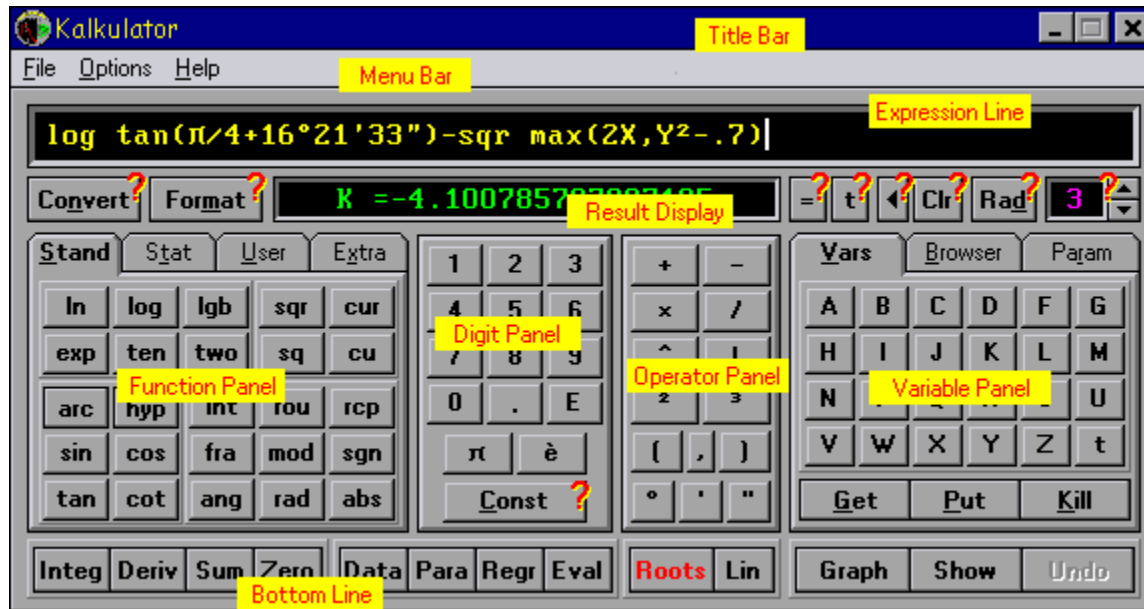
Quick start: an overview of the Main Panel
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Credits and copyrights

The Main Panel

Click on the yellow stickers for more information about Main   Panel components. Clicking on the red question marks will bring up a brief information on operations performed by selected buttons.

See also: Customizing Kalkulator

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What does Kalkulator do?

At its simplest level, Kalkulator is a calculator. It will accept an <u>arithmetic expression</u>, compute its value, display the result and   store it for a later use. For example, entering

```
5+3*log 1000
```

and pressing Enter will compute and display the expression value, 14, storing it as t (the <u>Temporary Variable</u>, used unless you specify another one). Instead of pressing Enter, you may use the "=" key (or button), to choose a variable from a pop-up menu; this variable will be used to store the result.

<u>Variables</u> can be also used as components of expressions, as in

```
2.5*ln(3+exp X)-sin(2A+3t)
```

Being able   to see the whole expression before and after evaluation, you can modify and recompute it at any time. This already is enough to justify using Kalkulator instead of any alternative. (Try to compute the same expression with any other calculator program.)

An expression can be   more than   just evaluated. Treated as a function   of   t, it can be used to compute integrals, derivatives, sums or roots. It can be also plotted on the screen.

The calculation result can be converted between various <u>measurement units</u>, or displayed in a <u>selected format</u> (for example, as a fraction or as degrees, minutes and seconds).

Kalkulator also has a <u>data buffer</u> to store a number of data points; it can perform simple <u>statistical operations</u> on those points: computing population parameters, drawing histograms or scatter plots (with polynomial curve fitting), etc. It will also recompute, using a given formula,   all X or Y values in the buffer.

Last but not least, Kalkulator can be also used for linear algebra: vector and matrix operations. This includes solving systems of simultaneous linear equations, quite a common problem in many scientific and engineering applications.

New in this version

This page contains links to topics new (or significantly changed) in the recent Help updates, so that the users upgrading from older versions do not have to read everything from cover to cover.

HOT NEWS: The Mother of all Calculators gave birth to a healthy baby calculator; its name is Mighty Midget. Check him out.

MORE HOT NEWS: Now you can register Kalkulator using your credit card (via phone, fax or World Wide Web). Well, I'm leaving you no excuses...

New in Version 1.29
A "Stay on Top" option for Minimal Layout has been added, see Panel Options.

The Escape key no longer closes the graph panel; now it always clears or restores the Expression Line.

A bug occurring in data point insert operation in the XY mode has been fixed.

Some limitations regarding the graph range have been introduced.

New in Version 1.28
The definition of harmonic average has been fixed – see Standard Functions.

New in Version 1.26
The Auto Scroll option has been added (moving to the next line when an expression has been computed). Minor changes in handling of user input errors in Data Grids. New items in Questions and Answers.

New in Version 1.24
Kalkulator now finds real and complex roots of polynomial equations with real coefficients (up to the third degree, or up to the fourth in the registered copies).

Most of the input dialogs have now context-sensitive help, activated by pressing the F1 key.

The on-line help regarding numerical operations has been enhanced.

New in Version 1.23
A bug, introduced in 1.21 and causing a refusal to compute derivatives and sums, has been fixed.

New in Version 1.20
A significant new feature has been added: linear algebra operations (vector and matrix arithmetic, including systems of linear equations). It is covered in the following topics:

Linear algebra
Vectors and matrices
Linear algebra operators
Vector and matrix editor

The same entry mechanism as used in the vector/matrix editor has been put to use in the dialog box used to modify the contents of the Data   Buffer. For more on this subject, see

Minor changes and improvements include:

- Right-clicking inside <u>Variable Panel</u> will show the variable (or statistical parameter) under the mouse cursor with the full sixteen digits of accuracy.

- In order to bring up the Main Popup Menu when the Main Menu is not visible, you have to right-click on the <u>Main Panel</u> border (not just anywhere in the Main Panel).

- The reciprocal function had to be renamed from inv to <u>rcp</u> (to make room for the matrix inversion operator).

Linear algebra
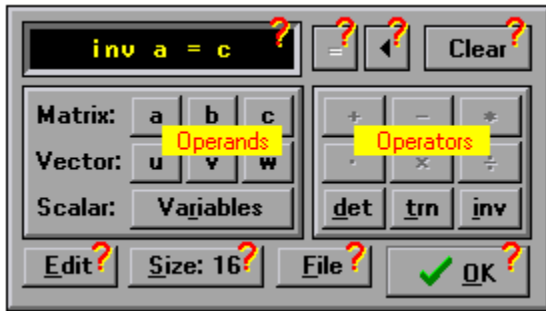
To perform operations on vectors and matrices, open the Linear   Algebra Panel by clicking on the [Lin] button in the Bottom Row.

From here, enter one or two operands and an operator, then click on the [=] button (or press the "=" key) and select from a pop-up menu the object to store the result.

All buttons have keyboard equivalents; the only ones which may not be obvious, are: "x" for cross-product, "." for dot-product, "/" for linear equations systems and Escape to clear the display. Pressing Escape again when the display is clear, will exit the dialog.

Click on the yellow stickers or on question marks for explanation of various elements of the Linear Algebra Panel.

See also:
   Vectors and matrices
   Linear algebra operators
   Vector and matrix editor

Vectors and matrices

Linear algebra operations use, in addition to Kalkulator underlined variables A..Z (scalars), six data objects: three vectors (u, v and w) and three matrices (a, b and c).

All matrices are square, and there is no visible distinction between row and column vectors. The character of a vector is always obvious from the context, e.g., in the a×v operation the vector v is understood to be a column – this multiplication does not make sense for v being a row vector.

The size of matrices and vectors (the same for all objects) can be set to anything between 2 and 4 (in registered copies: 16) by clicking on [Size] in the Linear Algebra Panel. This operation will also set all vector and matrix elements to zero.

Individual elements of matrices and vectors can be used in Kalkulator expressions: their values are accessed with fetch functions a#, b#, c#, u#, v# and w#.

Linear algebra operators

These operators are accessible from the <u>Linear Algebra Panel</u>. They can be divided into two groups. In the listings below M stands for any matrix (a, b or c), V for any vector (u, v or w) and S for any scalar (Kalkulator variable A..Z).

The first group, unary operators, accept a single operand in the prefix notation.

- det   computes the determinant of a matrix:
  ```
  det M = S
  ```
- trn   transposes a matrix, i.e. changes rows into columns and vice versa:
  ```
  trn M = M
  ```
- inv   performs matrix inversion:
  ```
  inv M = M
  ```

The second group are binary operators, accepting two operands in the infix notation.

- +   computes the sum of two objects of the same kind:
  ```
  M + M = M      V + V = V
  ```
- –   does the subtraction in the same manner
- *   finds the product of two operands (not necessarily of the same kind), according to the standard linear algebra rules. The following combinations are possible:
  ```
  M * M = M      M * V = V      V * M = V      V * V = M
  M * S = M      S * M = M      V * S = V      S * V = V
  ```

  In the case of M*V the vector is treated as a column (and the result is a column vector as well), while   for V*M both the vector operand and the result are row vectors – these are the only combinations allowed by the rules of linear algebra.

  For the product of two vectors the first one is understood to be a column, and the second one, a row (an outer product).

- ·   is the inner product (the dot-product) of two vectors:
  ```
  V · V = S
  ```

  Note that u·u computes the square of the norm (length) of u.

- ×   is the cross-product of two vectors, defined only for vectors of size 3:
  ```
  V × V = V
  ```
- ÷   is the operator to solve systems of simultaneous linear equations. The operation
  ```
  M ÷ V = V
  ```

  finds the solution vector of a system defined by the matrix and vector arguments. For example, the operation "a÷v=u" will solve the system usually written down as "a*u=v" (now you see why Kalkulator uses here an operator looking somewhat like division).

There are no rules against storing the result of an operation in one of the operands: the operation "a*u=u" will be performed properly; the old elements of u will be overwritten only when no longer needed in the multiplication.

A matrix or a vector can also be assigned to another, as in "a=b" or "v=u". Note that the destination object follows the "=" here.

Vector and matrix editor

Matrix a				
	1	**2**	**3**	**4**
1	0.396	−24.75	6.20608541903	682.784063255
2	−0.04507034145	11.7	−1.756389E−20	−0.5
3	865.255979432	66.3333333333	1	0
4	82.5	511428.571429	−82	11.3

[Zero] [Undo] [Format]   ✔ OK   ✘ Cancel   ◄ ►
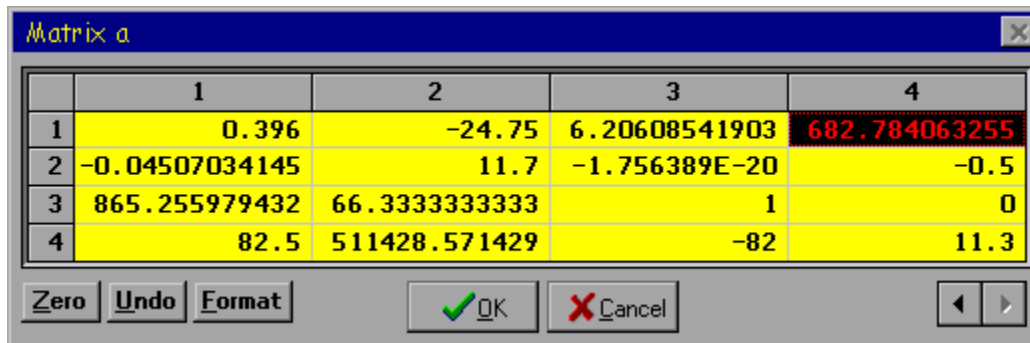
This editor (shown here for a 4*4 matrix) uses a data grid to enter values of vector or matrix elements.

- [Zero] sets all elements of the edited object to zero.
- [Undo] restores the object to the original state, as it was just before the editor was invoked.
- [Format] changes the display format between fixed-point and exponential. The third, "default" option uses the format depending on the displayed value; it also drops the trailing zeros from the display.
- The arrow buttons (visible only if needed) move to the left or to the right.
- [OK] exits the editor making the changes permanent.
- [Cancel] exits as well, undoing all the changes (the Escape key may be used to the same effect).

See also:
   Data Grids

Data Grids

These grids are used to manipulate the elements of vectors and matrices, and the contents of the Data Buffer. They provide (courtesy of Borland) a uniform user interface to these tasks.

At any moment, one cell of a grid is selected (drawn highlighted). Pressing any alphanumeric key (or Enter) will start editing that cell.

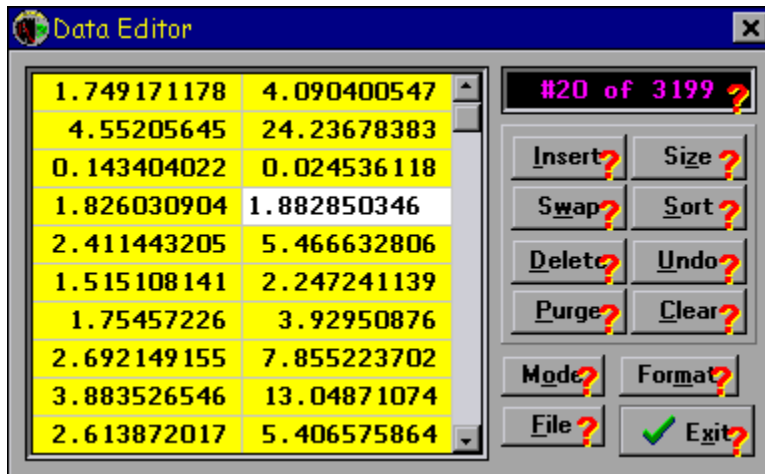Data grid cells accept not only numerical input: any legal Kalkulator expression can be entered.

When a cell is being edited, pressing Enter again (or moving to another cell with arrow keys, Tab or mouse) will confirm the changes. This will be prevented if the entry contains an error; an appropriate error alert will be displayed instead.

If Escape is pressed before the editing of a given cell is complete, the previous contents of the cell will be restored. Pressing Escape when no cell is being edited will exit the editor of which the data grid is a component.

Moving around a grid is done with arrow keys (the left and right arrow will work this way only when no cell is being edited). The Tab key is also used to move on to the next cell. The Page Up and Page Down keys retain their customary meanings, and Ctrl-Home or Ctrl-End can be used to go to the first or to the last cell in the grid.

Although grid cells display data with limited accuracy, the data remains stored with the full precision in which it was entered or computed. Even if you start editing a cell (e.g., by accident) the data will not be truncated to the displayed accuracy if you leave the cell without modifying its text.. To see the full-length representation, click on a cell with the right mouse button

Data Editor

1.749171178	4.090400547	#20 of 3199 ?
4.55205645	24.23678383	
0.143404022	0.024536118	Insert? Size ?
1.826030904	1.882850346	Swap? Sort ?
2.411443205	5.466632806	Delete? Undo?
1.515108141	2.247241139	
1.75457226	3.92950876	Purge? Clear?
2.692149155	7.855223702	
3.883526546	13.04871074	Mode? Format?
2.613872017	5.406575864	File ? ✓ Exit?

From here you can manipulate the contents of the Data Buffer.

The grid at the left displays the data (X and Y columns shown in this picture). More about using it can be found in the Data Grids topic.

To find out about operations performed by the buttons on the right, click on the hot spots marked with question marks.

Instead of entering the data manually, you can also use the current expression to compute the values of points in the X or Y column. This feature is accessed via the [Eval] button in the Bottom Row of the Main Panel.

The data in the buffer is saved together with the program status when you exit Kalkulator, to be automatically read back when you run it the next time. The registered version also allows to save the data to a separate text (ASCII) file and to load it from there.

See also:
   Computing data points

Computing data points

The expression in the <u>Expression Line</u> can be used to compute new values for the points in the <u>Data Buffer</u>. To do it, use [Eval] in the <u>Bottom Line</u>.

A pop-up menu will give you a choice between computing all x-values or only those tagged as <u>bad data</u>; in the XY mode there will be also these options for y-values.

Kalkulator will compute the expression value and assign it to every data point as chosen above.

All this would not have much use, if not for the fact that the expression defining the computed values may refer (via <u>fetch functions</u> <u>x#</u> and <u>y#</u>) to the existing data points, and to the index, denoted with the dummy variable t,   of the point being computed. Thus, for example, the expression

```
y#t+.5x#t
```

used to compute all y values, will replace every y in the buffer with its previous value incremented by half of the value of the corresponding x. In other words, this is a full-fledged column arithmetic.

Another common use of this feature would be to replace all bad data values with a given constant, e.g., zero.

For some purposes (not only educational) it may come handy to use the <u>random number generators</u> in computing the data points in the buffer.

Registration and support

Kalkulator is distributed as shareware: you are granted a trial license for a period of 30 days to see whether you will find the program useful and worth the price I'm asking. After that you have the options of either registering (purchasing) Kalkulator, or removing it from your system.

If you decide to keep Kalkulator, registering will bring you additional benefits: enhanced features, free updates and technical support. Last but not least, the program will get rid of the nagging screen which starts showing up after one month expires.

Technical support is offered not only to registered users, but also (to a reasonable extent) during the trial period. If you have any questions, problems or suggestions, feel free to send me email:

CompuServe: 70611,2552
Internet: 70611.2552@compuserve.com   or   wrotniak@freeflight.com

You may also write at my postal address (although this is much slower):

Dr. J. Andrzej Wrotniak
2057 Happy Lane
Crofton, MD 21114-1917
USA

And, most importantly, let me know what you like and dislike about the program: what new features would you like to see, what do you find inconvenient, confusing or mathematically incorrect (nah!). Your feedback is most valuable in making Kalkulator the program I want it to be.

See also:
How to register
Passing copies on to others
Updates and upgrades
How to get the newest version
Vendor Information
Orders from Poland (Zamówienia z Polski)

How to register

You may spend your money on Kalkulator (well, at least you've tried it and you know whether it is worth the expense!) in one of the following ways, listed from the fastest to the slowest:

- CIS subscribers may register <u>electronically via the CompuServe</u>. You should get the key within 24 hours.
- If you have access to the World Wide Web, you may use your credit card to register via <u>Public Software Library on WWW</u>.
- You may also place a credit card (VISA, MC, AE) order with <u>PsL by phone or fax</u>.
- You may send a check or money order <u>directly to my address</u>. Using this method, check for the <u>available discounts</u>!
- Finally, you may order with <u>PSL via mail using your credit card</u>.

In all cases the price is a fixed $40, all-inclusive. (Hurry up: from January 1, 1998 it goes up to $50!) Thank you. Please include the following details with your order:

- Your shipping address, if you would like to have a diskette mailed (please state clearly if so).
- Your email address, if applicable, in which case I will just send you the registration file, <u>KALKUL.KEY</u>, via email – this is the fastest (and cheapest, for me at least!) way.
- The version number of the evaluation copy you have (optional).

Your registration covers both the 16-bit (Windows 3.1) and 32-bit (Windows 95) mutations of Kalkulator. For corporate and institutional users <u>site licenses</u> are available.

See also:
<u>Registered version: enhanced features</u>
<u>Orders from Poland (Zamówienia z Polski)</u>

Registered version: enhanced features

The registered version of Kalkulator enhances some of the features of your evaluation copy:

- The program uses 24 expression lines, not just six
- An expression can be up to 120 characters or 72 tokens long (up from 60 or 36, respectively)
- The maximum size of vectors and matrices is 16 (as opposed to 4)
- The polynomial regression goes up to the ninth degree, not to the second
- Roots of polynomial expressions up to the fourth (not just the third) degree are computed
- The data buffer stores 6400 or 3200 data points (X or XY mode, respectively), not just 128 or 64
- Multiple status (.KAL) files can be used
- There is a capability to write the data buffer and linear algebra objects to an ASCII file or to read from one; this allows to exchange the data with other programs
- You can reseed the random number generators

Really, there is no separate "registered version". Any copy of Kalkulator will become "registered" when it finds in its directory a small registration file, named KALKUL.KEY. This file contains the license owner name (displayed on the program startup) and the proper verification information. It will stop working if modified in any way.

See also:
   How to register

Zamówienia z Polski

Zdajac sobie sprawe z tego, ze amerykanska cena Kalkulatora moze byc zbyt wysoka na srednia polska kieszen, zamowienia z Polski przyjmowane sa na specjalnych warunkach, z cena ustalona ponizej 30% ceny w Stanach Zjednoczonych.

Aby zakupic program, wyslij czek lub przekaz pocztowy na sume 30 zlotych (nowych!) na adres:

Dr Andrzej Krys
ul. Marusarzowny 6/70
94-041 Lodz

W zamian otrzymasz poczta dyskietke z najnowsza wersja programu zarejestrowana na Twoje nazwisko. Plik rejestracyjny KALKUL.KEY udostepni Ci wszystkie rozszerzenia funkcjonalnosci Kalkulatora nie tylko w wersji biezacej, ale do v2.00 wlacznie (dobrych kilka lat!).

Uwaga: Plik rejestracyjny KALKUL.KEY nie jest przeznaczony do rozpowszechniania; jest on Twoja wylaczna wlasnoscia i zawiera Twoje dane. Sam program (nie wlaczajac pliku KALKUL.KEY), moze byc dowolnie kopiowany i rozdawany komu zechcesz, tak dlugo jak nie pobierasz za to oplat z wyjatkiem rownowartosci ceny dyskietki.

Passing copies on to others

You are allowed (and even encouraged) to pass unregistered copies of Kalkulator along as long as you do not alter the original distribution files and do not charge money for the program.

Distributing of the original .ZIP archive (or a floppy with its freshly unpacked contents) is recommended: if you just take the files off your system, Kalkulator will count the elapsed part of your trial period towards that of the new recipient.

Your personal registration file, KALKUL.KEY, is not redistributable.

Updates and upgrades

A program is like a living thing: it evolves, grows, changes. Kalkulator is no exception here and it follows the same pattern.

Every new release of our program is denoted with a decimal version number, for example, 1.53. The following numbering scheme has been adopted:

- A change in the last decimal digit (e.g., from 1.53 to 1.54) denotes a minor update. These are maintenance releases, including bug fixes, touch-ups and minor improvements.
- A change in the first digit after the decimal point (e.g., from 1.54 to 1.60) denotes an update: some new features, visible improvements to the user interface etc.
- A change in the digit preceding the decimal point (major version) reflects an upgrade, containing significant new features. Possible examples of new features justifying an upgrade (these are NOT promises!) might include matrix algebra, complex variable arithmetic or differential equations; usually more than one such feature at a time.

Updates to Kalkulator are free (if distributed electronically), and upgrades for registered users, significantly discounted.

See also:
Update and upgrade policy
Where to get the newest version

Update and upgrade policy

Updates

For registered users of Kalkulator, updates within the same major version are free. This means that, for example, those who registered Version 1.12 do not pay for updating to versions up to 1.99 inclusive, regardless of when these new versions are released.

After you <u>download the new version</u> from an on-line service (or get it from any other source), just copy its files into the directory where your registered Kalkulator resides (do NOT delete any of the old files!), and the program will recognize your registration.

If you prefer to have a disk with the update sent to your address, this service requires a shipping fee of $5.

Upgrades

Program upgrades to the next major version will be available to registered users of previous versions at a 50% discount from the new version price.

If, however, an upgrade is released within six months from the date you registered the program, you can receive it as if it were an update (emailed for free, shipped for $5).

Where to find the newest version

The newest version of Kalkulator can be downloaded at no cost (other than the connection itself, that is) from one of the following sources:

- World Wide Web, courtesy of my employer, Aerospace Engineering and Research, Inc. This is the Kalkulator's primary distribution site; the most recent version can be available here a couple of weeks before it appears anywhere else. Point your browser to

    http://www.freeflight.com/wrotniak/

- CompuServe: the Science Forum (GO SCIENCE), Library 5 (Mathematics), file name: KALKUL.ZIP or KALK32.ZIP (16- or 32-bit version, respectively).
- America Online: Software Libraries – Windows – Applications – Productivity – Calculators – KALKUL.ZIP (you may have to search for the file by name, as the AOL people tend to move things around).

The Mighty Midget, Kalkulator's offspring, can also be downloaded from the locations listed above.

Vendor information

Non-registered copies of Kalkulator can be distributed by BBS operators, on-line services, disk and CD-ROM vendors after obtaining my explicit permission.

This permission is not required for vendors and BBS operators approved by the Association of Shareware Professionals. In these cases contacting me, although not required, is still recommended, as I may be able to provide the most recent version of the program.

In any case it is required that

- All files in the original distribution archive are included without alteration, as listed in the PACKING LIST section of the accompanying README.1ST file.
- The recipient of the program is informed in advance that the distribution fee paid to the vendor is not equivalent to purchasing the program: a registration is required if the recipient continues using Kalkulator after the expiration of the trial period.

See also:
   The author's address
   The author's email address

16- and 32-bit versions of Kalkulator

In releases later than 1.20, Kalkulator has two parallel versions:

- 16-bit version, developed for Windows 3.1 (3.11, etc.)
- 32-bit version, running only on Windows 95 and NT (in native 32-bit code)

Frankly speaking, the 16-bit version runs just fine under Windows 95 or NT, and there are not too many reasons to move to the 32-bit version of Kalkulator. Putting aside cosmetic differences in appearance (differently shaded buttons, somewhat different Function Panel and Variable Panel), there are two areas where Kalkulator/32 is better than its 16-bit counterpart:

- File operations (available in the registered version) use the Windows 95 file selector, and allow for long file names.
- Arithmetic operations have been speeded up more than by a factor of two. This is most noticeable in numerical integration or in drawing graphs of complicated functions.

I am planning to provide updates and upgrades of Kalkulator/16 at least until the end of 1996. After that the 16-bit version will be gradually phased out, with support limited to program maintenance (mostly bug fixes), unless there is an overwhelming reaction from the users of the program. Let me know.

Registered users of Kalkulator/16 can switch to the 32-bit version at no cost: just download the program, and it will recognize your original registration (key) file.

See also:
How to get the newest version

Evaluating expressions

First, enter the expression into the Expression Line. Use the mouse or type the expression in. In the latter case you will need to use special keystroke combinations to enter some of the symbols.

The expression syntax follows (mostly, at least) the customary "blackboard" notation. The maximum expression length is 60 characters or 36 tokens (operators, variables, constants or separators); in the registered version these limits have been increased to 120 characters or 72 tokens.

After the expression has been entered, you have to tell Kalkulator where to store the result: press the "=" key or click on the [=] button, then select a variable from a pop-up menu. Instead of doing that, you may just press the Enter key -- the result will then be stored in the Temporary Variable, t.

If the expression syntax is not proper, an error will be reported and you will be able to correct the mistake. The cursor will be placed at the error.

Otherwise Kalkulator will try to evaluate the expression. Some errors may occur at that stage (e.g., division by zero, or referring to a variable without a previously assigned value). If this is the case, another error alert will show up.

In no case should an error in an expression make Kalkulator crash or misbehave in any other way. All that may happen is an error alert, specifying the function or operator where the error occurred.

The result of the calculation will be shown in the Result Display. The [Format] button can be used to change the display precision and/or format.

The evaluated expression stays displayed in the Expression Line, unless the Auto Scroll option is on.

See also:
   Checking expression syntax
   Expression syntax
   Accuracy

Checking expression syntax

You may check the syntax of the current <u>Expression Line</u>, without actually computing it, by pressing Ctrl-Enter. If an error is detected, a diagnostics will be displayed; if the syntax is OK – the expression will just briefly blink green.

Expression syntax

Functions and operators are executed from high to low priority:

- High: power, square, cube, <u>factorial</u>, <u>implied multiplication</u>, functions
- Medium: multiplication and division
- Low: addition and subtraction, unary plus and minus

An operand with operators on both sides will associate with the higher priority operator of the two. If both priorities are the same, then the left operator (low and medium priority) or the right one (high priority) is applied first.

This order, following the customary "blackboard" notation, can be arbitrarily changed with parentheses. Of course, you may always do it when in doubt.

See also:
<u>Expression syntax examples</u>
<u>Syntax restrictions</u>
<u>Upper and lower case</u>
<u>Implied multiplication</u>

Expression syntax examples

```
2*sin 2x     means   2*sin(2*X)
2sin 2*x             2*sin(2)*X
a^b^cd               A^(B^(C*D))
a+b*cd^3.1           A+(B*(C*(D^3.1)))
a sin hx             A*sin(H*X)
asinh x              asinh(X)
ln x²                ln(X²)
```

Syntax restrictions

The "blackboard" notation is not always clear and consistent. Therefore, to avoid ambiguous expressions, we have to introduce a number of (hopefully, reasonable) restrictions.

- High-priority   operators: ², ³, !, ^, <u>implied multiplication</u>, cannot follow   a parenthesis enclosing a function   argument (or arguments)

For example, the sequence "log(x)²" is illegal; it should be changed into "(log x)²" or "log(x²)", depending on the intended meaning. On the other hand, "log x²" is OK and means "log(x²)".

- Sequences like "sin²x", often used to denote "(sin x)²", are not recognized; the latter, explicit form has to be used.

See also:
   <u>Implied multiplication</u>

Implied multiplication

The multiplication operator, ×, between two tokens (operands or symbols) can be skipped if

- the first one is a variable, a constant, a postfix operator or a closing   parenthesis (except when used for function arguments), AND
- the second one is a variable, a symbolic constant, a function, or an opening parenthesis.

The difference   between explicit   and implied   multiplication is that the latter has higher priority.

Examples:

```
    Legal           Equivalent to       Illegal

    3VXZ            3*V*X*Z             VX3Z
    2¶R             2*¶*R               2 3.14R
    9 sin X         9*sin(X)            sin(Y)sin X
    ln X exp Y      ln(X*exp(Y))        ln(X)exp Y
    sin 2AB         sin(2*A*B)          sin(2A)B
    sin X(A+B)      sin(X*(A+B))        sin(A+B)X
    ¶R²             ¶*(R²)              R²3.14
    (A+B)(C+D)      (A+B)*(C+D)         ln(A+B)(C+D)
```

Note

The traditional notation is not quite consistent: "exp 3 ln X" is usually interpreted by a human reader as "exp(3×ln(X))" while "2 sin X cos X" as "2×sin(X)×cos(X)". Kalkulator always chooses   the first way, interpreting the latter example as "2×sin(X×cos(X))".

See also:

Syntax restrictions

Upper and lower case

Expressions do not have to be entered in a case-sensitive manner. If a lowercase letter does not make sense in a given context, it may be raised to uppercase (becoming a variable).

This is convenient, as most of us prefer to type "2axsinyh" rather than "2 AX sin YH", letting the computer to sort it out.

Note, however, that typing "2xasinhy" will be interpreted as "2X asinh Y": the program recognizes "asinh" as a function name and promotes to uppercase only as few characters as necessary.

In case of doubt, you may always add a separating space, or enter a variable name in upper case (it will never be demoted to lower).

Accuracy

The internal accuracy of individual arithmetic operations performed by Kalkulator is 19 good decimal digits or better. These errors will, however, accumulate in computations involving multiple operations, so that 18 good digits is a safer assumption.

Moreover, algorithms used to compute some less trivial functions may have their own, additional error margin.

To be on the safe side, Kalkulator displays only sixteen significant digits of results. In a great majority of cases all these digits will   be valid with a reasonably large safety margin.

(Keep in mind, however, that for any finite floating-point accuracy one can easily invent an example of a computation where the relative result error will be 100% or more – i.e., all decimal digits wrong.)

See also:
   Problem with Microsoft System Agent
   The Pentium bug

Known problems

Problems with the Windows 95 System Agent

Microsoft admitted (in a quite understated way) that the System Agent, included with the Win95 Plus, messes up some floating-point calculations and that the problem will be fixed in one of the upcoming Windows 95 Service Packs.

In addition to reducing the Kalkulator accuracy from 19 to about 16 digits, this problem may also affect reformatting the result as a fraction (when you choose "Fraction" from the menu popping up after clicking on "Format" in the Main Panel).

I was able to check this out – indeed, this is the case. My recommendation is to turn the System Agent off when using Kalkulator (and who needs this thing anyway?). If the System Agent is present, you will see its icon in the tray at the right end of the launchpad.

To check for yourself,   type in (notice twenty 3's after the decimal point):

```
1/3-.33333333333333333333
```

and hit Enter (Kalkulator will reformat the expression, truncating the decimal fraction from 20 to 18 digits). The displayed result should be near to 2E-20, but with the System Agent raising its little ugly head, it will be close to 2E-17.

Interestingly, only Intel processors seem to be affected; the Cyrix P150+ I'm using (and very pleased with) does not losa any precision.

Pentium bug

The infamous bug in some of the early Pentium processors is related to some division operations. Kalkulator detects a faulty processor and uses additional code to work around the problem. (Frankly speaking, it was the good people of Borland who took care of this: the Delphi compiler, used to develop this program, does it automatically.)

Unit conversion

Convert Last Result [×]

Convert	Area
From	sq.feet
To	sq.meters

✔ **O**K   ✗ **C**ancel
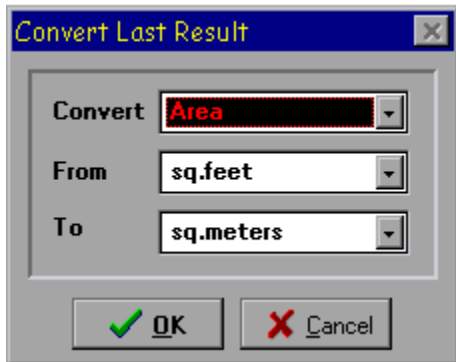
The value shown in the <u>Result Display</u> can be converted from one kind of measurement units into another. This will affect not only the display, but also the actual value of the variable to which it refers.

Clicking on the [Convert] button will bring up the Unit   Conversion Panel. It has three combo boxes with drop-down lists of items to choose from.

- The type of units, i.e. the physical quantity being converted (area, mass, etc.)
- The units to convert from – only these relevant to the selected type will be available
- The units to convert to (ditto)

The actual conversion will take place when we exit the panel by clicking on [OK]. Note that the variable storing the result will also be affected by the conversion.

Note: although the temperature is not, strictly speaking, a physical quantity, temperature conversion has been included under pressure from disgruntled program users.

Plotting functions

Plotting a function on an empty canvas

First, enter the function into the <u>Expression Line</u>, using t as the function argument (a "dummy parameter"). Then click on [Graph] in the <u>Bottom Line</u>. You will be asked for the x- and y-limits by the <u>Graph Range dialog</u>, from which you also can set one or both axes to a log scale.

The Graph Canvas will now show up, on which the drawing takes place, obscuring a large part of the Main Panel. The drawing process can be interrupted by pressing any key.

Hiding and showing the Graph Canvas

Click on [Hide] (or press Enter) to hide the Graph Canvas without erasing the graph. Click on [Show] (the same button, renamed at that time) to display it again.

Adding a function plot to an existing graph

While the graph canvas is active, you may click on [Add] to add the function defined by the current Expression Line to the canvas. Obviously, this time you will not be asked for the range. You also can add a function plot to an existing histogram or scatter plot, but not vice versa. The last added plot can be removed from the canvas by clicking on the [Undo] button.

Coordinate readout

A left mouse click inside the canvas invokes a pop-up menu with coordinates of the selected point. The menu allows you to store the x- and/or y- values of the point in the <u>variables</u> X and/or Y.
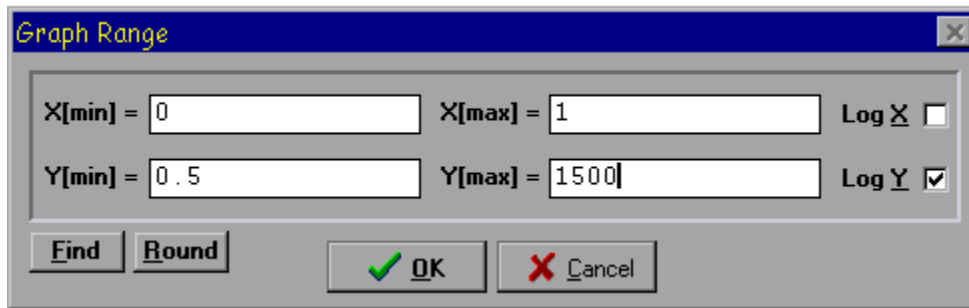
Copying canvas to clipboard

Pressing the F12 key while the Graph Canvas is up, copies the canvas to the Windows clipboard. From here it can be pasted into any application accepting the clipboard Paste command.

See also:
Graph range
Graph options

Graph range

The Graph Range dialog box is used to enter x- and y-limits for function plots and regression line graphs. Any valid arithmetic expressions can be entered.

Clicking on [Find] will estimate the y range for the x-limits previously entered, except for the case of regression graphs, where the x range will also be estimated. On a similar basis, the [Round] button will round the limits to "reasonable" values.

The buttons at the right set the x- and/or y-scale to logarithmic. Obviously, this requires that the corresponding range limits are positive.

Kalkulator imposes some limitations on the graph limits (x or y), otherwise an error message will be shown.

- In the linear scale the relative range width has to be not less than 1E-6. For example, while the range (0.999999,1.0) still fits within this limitation, the range 0.9999995,1.0) does not.
- In the logarithmic scale the range has to cover at least a factor of two; for example (4.0,8.0) but not (4.0,7.9).

See also:
Entering numerical values
Plotting functions
Polynomial regression

Entering numerical values

At some times Kalkulator will ask for some floating-point numerical values (e.g., plot range, integration interval limits, a new value for a variable, etc.) to be entered into editable fields of a dialog box.

The program will accept here not just literal values (i.e. numbers in a usual notation), but also any legal arithmetic expressions, following the Kalkulator expression syntax (with functions, variables and all). In case of syntax or evaluation errors, the appropriate diagnostics will be provided.

(In other words, any entry field becomes by itself a mini-Kalkulator. In order to compute a value and store it in a variable it is not necessary to go via the Expression Line: you may just click on [Put] in the Variable Panel and type the expression into the data entry box!)

If the dialog box stays open after the entered expression has been evaluated (this happens in some cases), the entry field will show just its value, not the expression itself. The display is limited to twelve decimal digits or so, but as long as the displayed text remains unmodified, the value is remembered with full Kalkulator accuracy. Once you type anything into the field, its contents will be re-parsed and evaluated again. (The same is true when the dialog is shown the next time, showing the previously entered values.)

The fields expecting integer (as opposed to floating-point) values do not accept expressions.

See also:
   Expression syntax

Polynomial regression

The [Regr] button in the Bottom Row is used to compute polynomial regression coefficients for the XY data points in the Data Buffer, i.e. to find the best least-squares polynomial fit to the data.

You can choose the polynomial degree from a pop-up menu (up to 2 in the trial version, up to 9 in registered copies of Kalkulator). This choice will be limited to values lower than the number of data points in the buffer, i.e., in order to draw a line of n-th degree you will need at least n+1 data points. The menu has also an option to just draw the points, without computing the regression.

The computed regression coefficients will be shown in the Parameter Page of the Variable Panel. They are denoted as a0...a9 (depending on the polynomial degree) and can be used as components of expressions.

After the regression coefficients have been computed, you will be given an option to plot the points and the regression line, and then asked for a plot range.

The function poly can be used at any time to compute polynomial values for the most recently computed coefficients (if any) and for a given argument value.

See also:
- Population parameters
- Parameter Page
- Variables
- Fetch functions
- Plotting functions

Population parameters

Clicking on [Param] in the Bottom Row will compute the parameters of the points in the Data Buffer:

- nn – the number of data points
- mx, my – mean values of x and y (if applicable)
- sx, sy – standard deviations
- vx, vy – variances
- x1, x2, y1, y2 – the minimum and maximum values
- cv – the covariance (XY mode only)

Parameter values are shown in the Parameter Page of the Variable Panel. Fresh values are displayed in green; when the data in the buffer changes, the color will change to olive.

The parameters will not be automatically recomputed when the buffer contents changes; this has to be done explicitly again. This means that old parameter values can still be used after data points have been modified (for example, you can use them in computation of new data values).

Parameter symbols can be used in expressions like variables. Clicking on a parameter value in the scrolling list will enter its symbol into the Expression Line.

See also:
Parameter Page
Polynomial regression
Variables

The Parameter Page

```
Vars   Browser   Param

x1:  0.03782570638  ▲
x2:  0.98713420398  ▒
my:  0.88774186697  ▒
sy:  0.16650410026  ▒
vy:  0.02772361540  ▒
y1:  0.60656466405  ▒
y2:  1.23191581485  ▒
cv:  0.01061870342  ▼
```

See also:

Population parameters

Polynomial regression

Variables

Variables can be used as elements of expressions and to store results of operations.

- There are 23 "regular" variables, from A to Z (excluding E, T and O). They are entered in upper case, although Kalkulator will recognize them anyway.
- t (lowercase!) is the Temporary Variable, used to store the last result sent to the Result Display (even if another variable was also used to store the result).
- When an expression is interpreted as a function (e.g., in plotting or in numerical operations), t is understood as the argument (dummy parameter) of that function.
- The symbolic constants, ¶ and é, behave in expressions exactly like variables, except that they cannot be assigned new values.
- The statistical parameters describing the points in the Data Buffer are also treated like read-only variables, i.e. once computed, they can be used as elements of expressions.

See also:

Accessing variables

Accessing variables

The buttons in the Variable Button Page can be used to enter variable names into the <u>Expression Line</u>. The same can be done by clicking on variable values shown in the Browser Page (except that <u>variables</u> without assigned values will not be available from there), or on values shown in the Parameter Page.

Setting, fetching and clearing variable values

The Variable Button Page and the Browser Page contain some buttons used for accessing or setting variable values (with variable selected from a pop-up menu):

- Get -- copy a variable value into the <u>Result Display</u> (and into the <u>Temporary Variable</u>, t)
- Put -- store a given value (you will be prompted for it) in a variable
- Kill -- clear a variable (it will have no value assigned)

Additionally, clicking on the Result Display (or pressing Shift-Enter) allows to store the last result in a selected variable.

See also:
   Variable Button Page
   Browser Page
   Parameter Page

The Variable Button Page

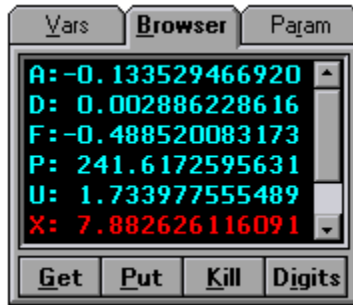| Vars	Browser	Param

A	B	C	D	F	G
H	I	J	K	L	M
N	P	Q	R	S	U
V	W	X	Y	Z	t

Get	Put	Kill

See also:

[Variables](#)

[Accessing variables](#)

The Browser Page

```
Vars  Browser  Param
A:-0.133529466920
D: 0.002886228616
F:-0.488520083173
P: 241.6172595631
U: 1.733977555489
X: 7.882626116091
Get  Put  Kill  Digits
```

See also:

[Variables](#)
[Accessing variables](#)

Fetch functions

These functions allow you to access values from the Data Buffer or the matrix and vector elements in order to use them as components of expressions. Their buttons can be found in the Extra Page of the Function Panel.

The data fetch functions are x# and y# (lowercase characters!). The latter function is available only in the buffer XY mode; an attempt to use it in the X mode will cause an expression evaluation error.

Similar fetch functions are used to access the values of linear algebra objects: u#, v# and w# for vectors, and a#, b# and c# – for matrices. The latter three functions use two arguments, first being the row, second – the column index.

An argument of a fetch function will be rounded to the nearest integer; its value can be from 1 to the number of points in the buffer or to the current size of linear algebra objects, respectively. A value from outside the legal range will cause an expression evaluation error.

Examples

```
(x#1+x#(i+1))/2
x#max(t-1,1)
```

Polynomial

There is one more function related to the data in the buffer: poly. It will use the current set of polynomial regression coefficients to compute a polynomial value for its argument. If the argument is x, then the polynomial is defined as a0 + a1*x + a2*x^2 + ...

Graph options

The [Options|Graph] menu entry brings up a dialog box allowing you to set the following:

- Grid – with this option enabled, a reasonably spaced grid will be drawn in the background
- Axes – (yes, that's plural of "axis"!), solid lines will be drawn for x=0 and y=0
- White Background – on some monitors graphs may look better this way; this is also the setting you may use when copying the a graph to the Windows clipboard to use it in another program.
- Fine Detail – this tells Kalkulator to be more cautious adjusting the step of the plotting process, so that functions with discontinuities, sharp peaks and dips can be drawn more accurately. For most purposes you may leave this setting at "off", unless you do not mind waiting a few seconds longer for the drawing to complete.
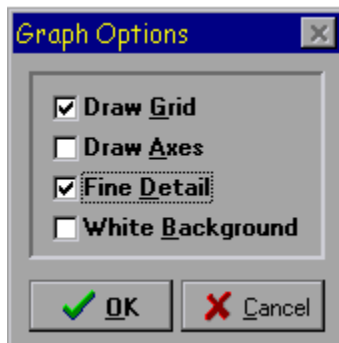
You can always invent a function to fool any graphing program. Kalkulator, however, is more difficult to fool than most. It adjusts the plotting step to the local line curvature and ignores non-computable points (singularities), still trying to approach them as close as reasonably possible.

To compare Kalkulator against any other function graphing program you have, try plotting "sin(1/t) for t from -1 to 1 with the Fine Detail setting at "on". Another good example is "int t".

Numerical operations

These operations are performed on a single-argument function f(t), defined by the current expression, displayed in the <u>Expression Line</u>. The dummy variable t has to be used as the function argument.

Clicking on [Integ], [Deriv], [Sum] or [Zero] in the <u>Bottom Line</u> will first bring a dialog box to define the parameters of the operation (e.g. argument limits, required accuracy). When these parameters have been entered, the operation is carried out, and upon its completion the result is stored in the <u>Temporary Variable</u>, t.

The computation can be interrupted while the red timer box is being displayed, by pressing any key (or clicking inside that box).

See also:
    <u>Computing integrals</u>
    <u>Computing derivatives</u>
    <u>Computing sums</u>
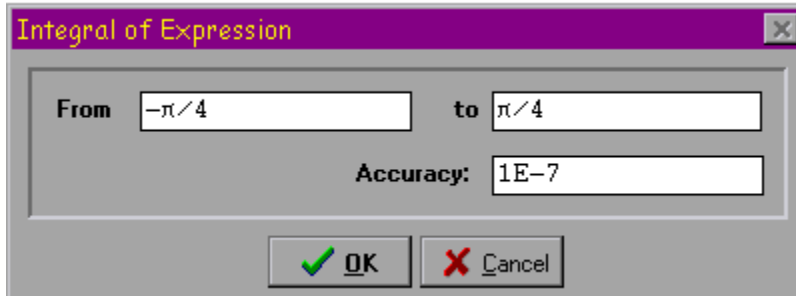   <u>Finding function zeros</u>
    <u>Entering numerical values</u>

Computing integrals

After a click on [Integ], Kalkulator will compute a numerical integral of the current expression treated as a function of the dummy variable t.

Integral of Expression ⊠

From $-\pi/4$ to $\pi/4$

Accuracy: $1E-7$

✔ OK   ✗ Cancel

A dialog box will prompt you for the integral limits, t1 and t2, and for the desired accuracy parameter, d.

The iterative computation process terminates when the difference between two consecutive approximations, h, is less than d*(1+abs P), where P is the last iteration result. This means that for P<<1 the value of d denotes an absolute accuracy, while for P>>1 -- a relative one.
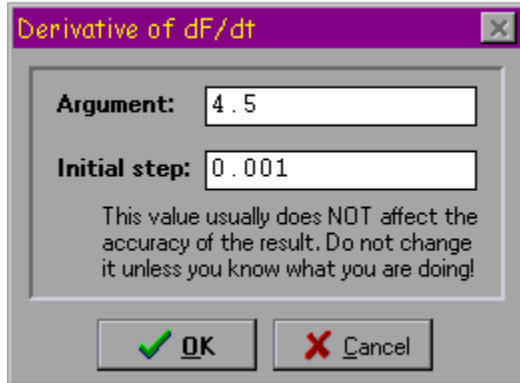
See also:
   Numerical operations
   Entering numerical values

Computing derivatives

When the [Deriv] button is clicked on, Kalkulator will compute the derivative of the current expression, treated as a function of the dummy variable t.

You will be prompted for the value of t, at which the function derivative, df(t)/dt, is to be computed.

The other field in the query dialog is the initial step of the step-adjusting algorithm used here (this is not the denominator of the finite increment approximation!). For most of well-behaved functions it never needs adjustments.

The result will be stored in the Temporary Variable, t.

Obviously, if you attempt to compute the derivative at a point where the function is not continuous, funny things may happen.
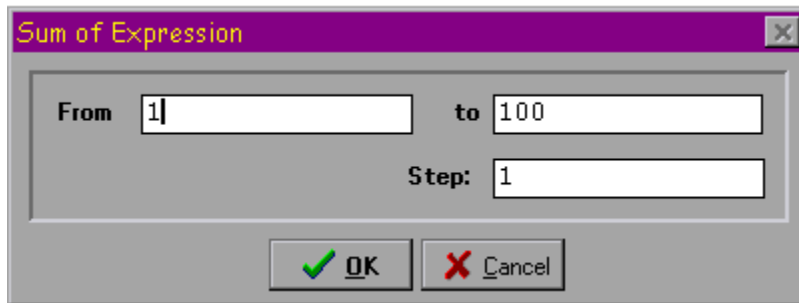
See also:
   Numerical operations
   Entering numerical values

Computing sums

Kalkulator will compute an indexed sum with term values defined by the current expression, with the dummy variable t used as the term index.

After clicking on [Sum], a dialog box will ask you for the index start and end value, t1 and t2, and for the step, dt.

The sum will be computed as   f(t1)+f(t1+dt)+...+f(t2).

More precisely, if (t2-t1)/dt is not an integer, then the last value of t will be t1+k*dt, where k is the largest integer for which t1+k*dt < t2+dt/2. This assures that any rounding errors are handled properly.
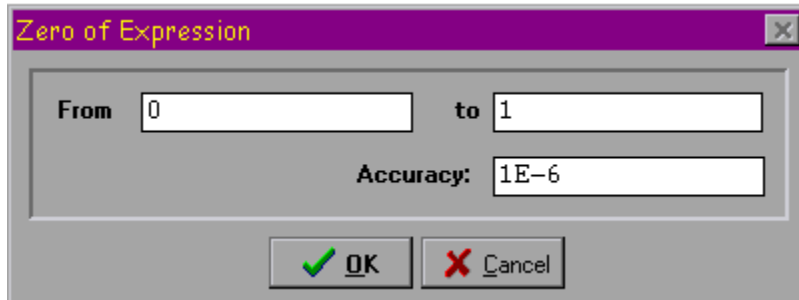
See also:
  Numerical operations
  Entering numerical values

Finding function zeros

This operation finds a value of t, for which the current expression, treated as a function of the dummy variable t, equals zero: f(t)=0.

After a click on [Zero], a dialog box will ask for the interval (t1,t2), bracketing the solution, and for the desired absolute accuracy, dt.
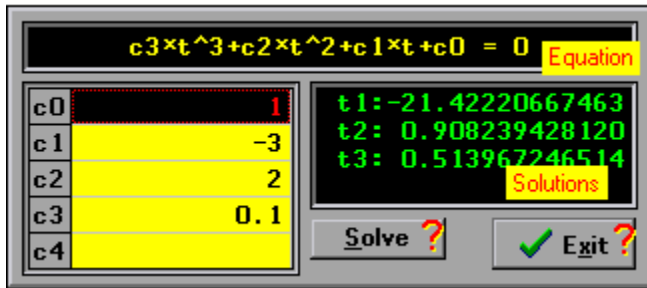
The interval (t1,t2) has to contain a single solution (or an odd number of solutions, in which case one of them will be found). If this is not the case, an error will be diagnosed.

See also:
Numerical operations
Entering numerical values

Polynomial equations

Pressing the [Roots] button in the Bottom Line brings up the Root Panel, used to find real and complex roots of polynomial expressions of up to the fourth degree (up to the third degree in non-registered copies).

In other words, the program finds solutions of an equation

```
c0 + c1*t + c2*t^2 + c3*t^3 + c4*t^4 = 0
```

where at least one of the real coefficients c1..c4 has to be non-zero. The coefficients are entered into the yellow data grid at the left.

Upon clicking on [Solve], the solutions are found analytically (i.e. without using any numerical approximations) and displayed in the panel at the right.

The real roots are denoted as t1..t4. If the equation has complex roots, their real and imaginary parts are shown as Re1 and Im1 (and Re2 and Im2, if applicable). Each real/imaginary pair defines a pair of conjugate complex roots, e.g., (Re1,-Im1) and (Re1,+Im1), sometimes also denoted as Re1-i*Im1 and Re1+i*Im1.

See also:
   Data Grids

Statistical operations

These operations are performed on data stored in the Data Buffer. The buffer may be in one of two modes: X (single data values) or XY (value pairs). The current mode is shown as [X] or [XY] in a button in the Bottom Row. Clicking on that button toggles the mode.

Topics:
    Data Editor
    Computing data points
    Population parameters
    Drawing a histogram
    Polynomial regression

Drawing a histogram

Clicking on [Hist] in the Bottom Line (in the X mode only) will draw a histogram of the points in the Data Buffer.
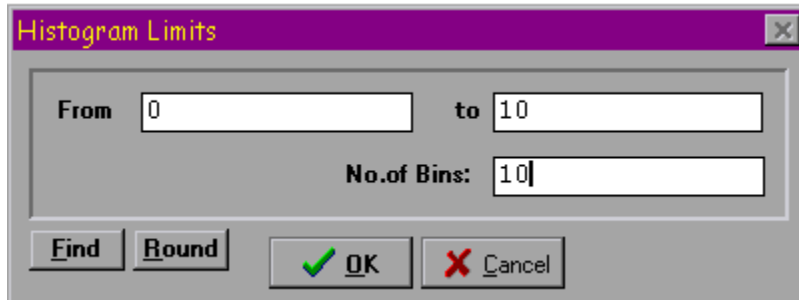
A dialog box will ask for the histogram limits and the number of bins (maximum: 50).

 You can use the [Find] and [Round] buttons to let Kalkulator do the work here: [Find] will find the range of data points and [Round] will round the range limits outwards to some sensible "round" values.

See also:
   Entering numerical values

Constants

Numeric constants

Constants are used as components of expressions. A constant consists of digits 0..9, an optional decimal point and an optional decimal exponent symbol, "E"; the exponent may be signed or not. For example, "1.5E-3" means the same as "0.0015". A zero preceding the decimal point can be skipped, as in ".0015".

A leading minus (or plus) sign is not treated as a part of a constant, but rather as an operator, although this is a purely academic distinction.

When an expression is reformatted before being computed, the constants in it may became reformatted as well, to a (possibly) simpler representation.

Important for European users: regardless of your regional settings, Kalkulator always uses a point, ".", as the decimal separator.

Angular constants

These are entered with use of digits and the symbols of degrees, minutes and seconds, available in the Digit Panel (to enter the degree symbol from the keyboard, use Ctrl-d).

An angular constant used in an expression will be converted to a number, corresponding to the angular value in radians or degrees, depending on the current Kalkulator angular mode.

Symbolic constants

There are two predefined symbolic constants: pi (3.14...) and Euler's e (2.71...). They are denoted with symbols ¶ and é, respectively, available as buttons on the Digit Panel. To enter them from the keyboard, use the Ctrl-p and Ctrl-e keystroke combinations.

See also:
   Physical constants

Physical constants

Kalkulator is aware of some elementary physical   constants.

Clicking on the [Const] button in the <u>Operator Panel</u> will bring a pop-up menu from which a constant can be selected. Its value will be stored in the <u>Temporary Variable</u>, t, and shown in the <u>Result Display</u> (from where it can be copied into any variable by a mouse click or by pressing Shift-Enter).

Operators

- The four basic operators: +, -, ×, /
- The <u>power operator</u>: ^
- <u>Factorial</u>: !
- Square and cube: ², ³
- <u>Implied multiplication</u>: · (a tiny dot, sometimes omitted at all)

When entered from the keyboard, some of the operators will require special <u>keystroke combinations</u>.

The multiplication operator, shown in the display as "×", is entered with the asterisk key, "*", which is a commonly accepted procedure. (In the examples shown here we will be using the asterisk as well.)

Operator priority

- High: ^, ², ³, ! and ·
- Medium: ×, /
- Low: +, =

See also:

<u>Expression syntax</u>
<u>Implied multiplication</u>

Functions

Arguments

Any arithmetic expression can be used as a function argument. Multiple arguments (in functions which expect them) are separated with commas.

Many of the functions accept just a single argument. If this argument is a number (constant), a variable, or another function call, then it does not need to be enclosed in parentheses. For example, "exp(3.8)-ln(X)" can be entered as "exp 3.8-ln X", but in "sqr(1+X)" the parentheses are necessary; without them the expression would be understood as "sqr(1)+X".

Function groups:

Standard functions
User functions
Conditional functions
Statistical distribution functions
Random number generators
Euler and related functions
Fetch functions
Feet, pounds, hours

Standard functions

These functions, accessible from the Standard Function Page, are usually considered "standard", whatever that means.

The following function groups can be identified here:

- Logarithms and exponents base e, 10 and 2: <u>ln</u>, <u>log</u>, <u>lgb</u>, <u>exp</u>, <u>ten</u>, <u>two</u>
- Roots and powers: <u>sqr</u>, <u>sq</u>, <u>cur</u>, <u>cu</u>
- Trigonometric and inverse: <u>sin</u>, <u>cos</u>, <u>tan</u>, <u>cot</u>, <u>asin</u>, <u>acos</u>, <u>atan</u>, <u>acot</u>
- Hyperbolic and inverse: <u>sinh</u>, <u>cosh</u>, <u>tanh</u>, <u>coth</u>, <u>asinh</u>, <u>acosh</u>, <u>atanh</u>, <u>acoth</u>
- Polar coordinate functions: <u>ang</u>, <u>rad</u>
- Other functions: <u>int</u>, <u>fra</u>, <u>rou</u>, <u>mod</u>, <u>abs</u>, <u>sgn</u>, <u>rcp</u>

Some other, "almost standard", functions can be found in the Extra Function Page:

- Smaller/greater choices: <u>min</u>, <u>max</u>, <u>mxa</u>
- Arithmetic, geometric and harmonic averages: <u>avg</u>, <u>gav</u>, <u>hav</u>

See also:
   Angular mode
   Extra Function Page

Angular mode

The current angular   mode is shown as [Rad] or [Deg] in a button to the right of the Result Display. Clicking on that button will change the mode.

Depending on this mode, Kalkulator assumes that arguments to trigonometric functions are expressed in radians or degrees. It will also return results of inverse trigonometric functions in the same units.

 Changing the angular   mode to degrees can often lead to some confusion. I would recommend staying in the radian mode and using the angular constants explicitly. Then the calculation results can be displayed in the desired angular representation as needed.

See also:
   Formatting the result

Formatting the result

Clicking on the Format button to the left of the <u>Result Display</u> offers (from a pop-up menu) a selection of various display formats.

- **Default** – a reasonable compromise, the choice between floating and fixed point is made based on number readability. The values are shown with the full accuracy of 16 significant digits, and the trailing insignificant zeros are omitted.
- **Fixed Point** – a fixed-point representation, with a selected number of digits after the decimal point (if the selected number would result in more than 16 significant digits, it will be appropriately reduced).
- **Exponential** – a floating-point display, with a selected number of significant digits (up to 16) and at least two digits in the decimal exponent.

Any of these three settings becomes "permanent" – it will hold for all future calculations until revoked. The other settings reformat just the current result.

- **Fraction** – the value is shown as a whole part and a fraction, e.g., 3.125 becomes "3 1/8". The largest denominator is 1000 and it will be used if the value cannot be exactly represented with a smaller one.
- **Deg-Min-Sec** – the value is shown in degrees, minutes and seconds of angle.
- **Degrees** – the value is shown as degrees of angle (with decimal fraction, if any).
- **Minutes** – minutes of angle.
- **Seconds** – seconds of angle (format used by astronomers).

The four angular formats above are affected by the current <u>angular mode</u> setting, Rad or Deg, as the result is assumed to be an angle, originally expressed in radians or degrees, respectively.

- **Feet & Inches** – the result is assumed to be in feet and it will be shown as feet, inches and fraction. For example, 1.24 will become "1 2 7/8" (one foot, two inches and 7/8 of an inch).
- **Lbs & Ozs** – the result is treated as pounds and shown as pounds, ounces and fraction.

The maximum denominator value for inches or ounces is 64.

- **Hrs-Min-Sec** – the result is treated as time in hours and displayed as e.g., 3:32:41

Obviously, depending on the displayed value and the format used, the display may be rounded. This never affects the actual result value, stored internally with 19 significant digits of accuracy.

Extra Function Page

Stand	Stat	User	**Extra**

min	max	ifn	ifz	ifp
avg	mxa	ft	lb	hrs
gav	hav	x#	y#	poly

a#	b#	c#	u#	v#	w#

See also:

Conditional functions

Feet, pounds, hours

Fetch functions

Standard functions

Conditional functions

The buttons for these functions are in the Extra Page of the Function Panel.

A conditional function accepts three arguments and, depending on the sign of the first argument, computes and returns the value of argument number two or three:

- ifz – "if zero", checks for the first argument being equal zero
- ifp – "if positive", checks for the first argument being positive (>0)
- ifn – "if negative", checks for the first argument being negative (<0)

The discarded argument is not evaluated at all; thus, for example, "ifz(X,1,sin X/X)" will be computed without an error for any value of X, including zero.

Note that functions for checking a "greater or equal" or "less or equal" condition are not necessary. Instead of invoking a hypothetical "if positive or zero" function ifpz(x,a,b) we may just use ifn(x,b,a).

Feet, pounds, hours

This group consists of three very similar functions, accessible from the Extra Page of the <u>Function Panel</u>:

- <u>ft</u>   converts feet and inches into feet
- <u>lb</u>   converts pounds and ounces into pounds
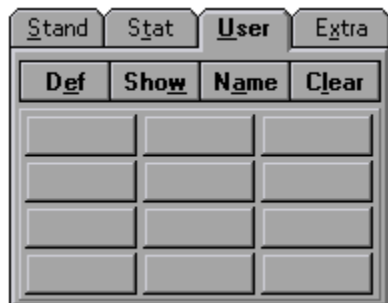- <u>hrs</u>   converts hours, minutes and seconds into hours

Example

This is how to compute the area of a rectangle 6 ft 7 in by 4 ft 3 5/8 in:

```
ft(6,7)*ft(4,3+5/8)
```

User functions

An expression can be used to define a new function of a single argument. This new function can then be used in other expressions.

Enter the function formula into the Expression Line, using t as the function argument, then click on [Def] in the User Page of the Function Panel. Choose a function slot from the pop-up menu, then enter the function name.
This name, consisting of lowercase letters and digits and starting from a letter, has to be different than any other function name.
If no syntax error is detected, the function will now be defined and its name will be shown in one of the user function buttons.

Nesting user functions

One user function may call another, but it cannot refer to itself, directly or indirectly. A check for that is made when an expression using these functions is evaluated.

Renaming and undefining user functions

This is done by clicking on [Name] and [Clear] in the User Page. You will not be allowed to rename or delete a user function if others are referring to it (you have to undefine those first).

Any references in expressions to a deleted or renamed function will now become invalid.

Displaying and modifying user functions

Clicking on [Show] in the User Page will display the function definition in the Expression Line. The function can now be modified and defined again.

Statistical distribution functions

Each of these functions can be identified by specifying two features: the distribution and the function type.

The top row buttons of the Statistical Function Page determine the type of the distribution function entered by the subsequent button clicks.

When the function type has been chosen, clicking on one of the eight buttons below the icons selects the distribution.

Accuracy

All distribution functions are usually computed with at least sixteen good decimal digits. (In a few cases, near distribution tails, this cannot be achieved within the 19-digit internal accuracy; any of these exceptions are reasonable and justified.)

For detailed information, see:

Types of distribution functions
Supported distributions
Glossary of distribution functions
Fractional arguments to distribution functions

Types of distribution functions

The buttons in the top row of the Statistical Function Page determine the type of the distribution function entered by the subsequent button clicks.

The first four   have their respective types shown by icons accompanied with a single letter. This letter denotes the function prefix as it will be shown in the <u>Expression Line</u> (and as it should be entered, in lowercase, from the keyboard). Our notation is similar to the one used in the <u>Handbook of Mathematical Functions</u>:

- the [F] button   –   a <u>distribution density</u> (or probability)
- the [P] button   –   a <u>left distribution integral</u>
- the [Q] button   –   a <u>right distribution integral</u>
- the [A] button   –   a <u>central distribution integral</u> (symmetric distributions only)

For the discrete distributions (Poisson and binomial) the term "distribution" density" should be replaced with "probability" and "integral" with "sum".

The rightmost button, [I], used together with one of the discussed above (P, Q or A), denotes an <u>inverse integral distribution</u>.

See also:
   Supported distributions

Supported distributions

The following statistical distributions are supported by Kalkulator. The three-letter distribution abbreviations listed below, are additionally prefixed with one or two letters denoting the distribution function type.

- gau   –   the Normal (Gaussian) distribution
- chi   –   the chi-square distribution
- stu   –   the t (Student) distribution
- sne   – the F (Snedecor) distribution
- poi   –   the Poisson distribution
- bin   –   the binomial distribution
- gam   –   the gamma distribution
- bet   –   the beta distribution

See also:

Types of distribution functions

Glossary of distribution functions

Here is the complete list of distribution functions provided by Kalkulator:

- <u>Distribution density</u> (or probability) functions: <u>fgau</u>, <u>fchi</u>, <u>fstu</u>, <u>fsne</u>, <u>fgam</u>, <u>fbet</u>, <u>fpoi</u>, <u>fbin</u>
- <u>Left distribution integral</u>   functions: <u>pgau</u>, <u>pchi</u>, <u>pstu</u>, <u>psne</u>, <u>pgam</u>, <u>pbet</u>, <u>ppoi</u>, <u>pbin</u>
- <u>Right distribution integral</u> functions: <u>qgau</u>, <u>qchi</u>, <u>qstu</u>, <u>qsne</u>, <u>qgam</u>, <u>qbet</u>, <u>qpoi</u>, <u>qbin</u>
- <u>Central distribution integral</u> functions: <u>agau</u>, <u>astu</u>
- Left <u>inverse integral distribution</u> functions: <u>ipgau</u>, <u>ipchi</u>, <u>ipstu</u>, <u>ipsne</u>, <u>ipgam</u>, <u>ipbet</u>, <u>ippoi</u>, <u>ipbin</u>
- Right <u>inverse integral distribution</u> functions: <u>iqgau</u>, <u>iqchi</u>, <u>iqstu</u>, <u>iqsne</u>, <u>iqgam</u>, <u>iqbet</u>, <u>iqpoi</u>, <u>iqbin</u>
- Central <u>inverse integral distribution</u> functions: <u>iagau</u>, <u>iastu</u>

See also:
   Types of distribution functions
   Supported distributions

Fractional arguments to distribution functions

While most of the distributions deal with random variates in the real domain, the binomial and Poisson distributions are usually considered for discrete (integer) arguments. Nevertheless, Kalkulator will compute these distribution functions also for fractional values, using the same formulae.

Similarly, some of the distribution parameters are in most applications integer (e.g., degrees of freedom). Kalkulator will, however, accept   non-integer distribution parameters, and use the same formulae as in the integer cases.

(There are statistical methods using fractional degrees of freedom: e.g., the test for equality of two sample means without assumption of equal variances.)

Random number generators

These functions return randomly (strictly speaking: pseudorandomly) a different result every time they are used. The randomness is organized, however: for each generator its results are sampled from a distribution defined by the generator function and its arguments.

Three generators are provided, accessed with buttons in the Statistical Function Page:

- ran – sampling from a uniform distribution
- rgau – sampling from a Normal (Gaussian) distribution
- rpoi – sampling from a Poisson distribution

Reseeding the generators

Every time you run Kalkulator, the sequence of basic pseudorandom numbers used in the generators described above starts from the same seed. This means, that if in two different sessions with the program you repeat the same sequence of generator function calls, the results will be identical.

This is not always desirable. This is why the registered version of Kalkulator allows you to initialize (reseed) the generators with any seed value of your choice. To do it, use the [Options | Reseed generators] menu entry.

Euler and related functions

These functions are grouped in the <u>bottom row</u> of the Statistical Page of the <u>Function Panel</u>:

- <u>gam</u> is the Euler Gamma function, related to the <u>factorial</u> operator: x!=gam(x+1).
- <u>bet</u> is the Euler Beta function
- <u>lgm</u> is the logarithm of Gamma (handles larger arguments)
- <u>com</u> is the combination function

Both gam and bet are complete Euler functions; the incomplete ones can be computed with use of the Gamma and Beta integral distribution functions, <u>pgam</u> and <u>pbet</u>.

Mouse

Kalkulator uses the mouse very much like any other Windows 3.1 or Windows 95 program. In particular, all menu items and all functions assigned to buttons are accessible with single clicks of the left mouse button.

The non-obvious uses of the left mouse button include:

- Clicking in the Browser or Parameter Page of the Variable Panel enters the celected variable (statistical parameter) into the Expression Line at the current cursor position.
- Clicking on the Result Display allows to store the displayed value in a variable, selected from a pop-up menu.

The right mouse button has been assigned a few special functions:

- When the Menu Bar has been removed with use of the Panel Options dialog, clicking the right mouse button at the edge of the Main Panel (the mouse cursor will change to show you are there) will bring up the Main Pop-up Menu.
- A right click in the Variable Panel (any of the pages) will show a pop-up menu with the value of the object (variable or parameter) under the cursor, displayed with the full accuracy.
- A right click within any of the data grids will display the selected value in the same fashion.

Right mouse clicks are among the few Kalkulator operations which do not have keyboard equivalents.

Double-clicking is not used at all in the program.

See also:
  Keyboard

Keyboard

In the Main Panel, most of the keyboard input goes into the Expression Line: all characters, Left and Right arrow keys, Home and End, Delete and Backspace. (Characters illegal in expressions will be just ignored, and characters without standard keyboard equivalents can be entered with use of special keystroke combinations.)

Additionally, all menu entries and many buttons have keyboard shortcuts defined in a standard Windows way: Alt + the underscored letter key.

To allow for using Kalkulator entirely without a mouse, some Main Panel operations have been assigned to keyboard shortcuts which are not obvious at a glance:

- Up and Down arrows – switch to the previous/next expression
- Page Up, Page Down – scroll through the values displayed in the Variable Panel (if the Browser or Parameters page is shown)
- Alt-Del or Escape – clear the Expression Line (storing the expression in a buffer)
- Alt-Ins – copy the buffer into the current line. If the line is not empty, it will be stored in the buffer (so that, effectively, a swap takes place).
- Enter – compute the current expression, storing the result in the Temporary Variable, t.
- Ctrl-Enter – check the current expression syntax, without evaluating it
- Shift-Enter – copy the value from Result Display into a variable (chosen from a pop-up menu)
- Alt-Left,   Alt-Right   – highlight the previous/next button in the Bottom Line
- Alt-Enter is equivalent to clicking on the highlighted Bottom Line button
- F1 – call Help (Table of Contents)
- F10 – show the Main Popup Menu
- F12   – copy the Result Display into the Windows clipboard, so that it can be pasted into any Windows application supporting clipboard operations

When the Graph Canvas is visible, the Enter key changes its meaning, being to hide the canvas. (Enter does not make much sense with the Result Display hidden.) At the same time, the F12 key will copy the Graph Canvas to the Windows clipboard.

The clipboard functions of Shift-Del (cut), Ctrl-Ins (copy) and Shift-Ins (paste) as defined in the standard Windows environment, can also be used in Kalkulator, applied to highlighted fragments of the Expression Line.

See also:
   Mouse

Menu operations

These operations are accessible from the Menu Bar and from the Main Pop-up Menu.

File

- Clear – clears everything: expressions, variables, user defined functions, data buffer, graph canvas.
- Exit – exits the program. There will be a warning and an option to save the program status to a disk file. The status is automatically read next time you run the program, so that you can continue the previous work.

The registered version has two more entries here:

- Load Status – loads the Kalkulator status (settings, expressions, user functions, variables, vectors and matrices, data buffer, graph canvas) from a .KAL file, created on the last exit from the program or by explicit use of [File | Save].
- Save Status – saves the Kalkulator status (see above) to a KALKUL.KAL file.

In non-registered copies, this file is saved on exit and read when the program is executed again, but you cannot have multiple *.KAL files.

Options

- Panel Options – shows the dialog to change some aspects of the Main Panel appearance and behavior.
- Graph Options – displays the dialog to change the graph settings.
- Reseed Generators – allows to reseed the random number generators.

There is also the usual Help menu.

Customizing Kalkulator
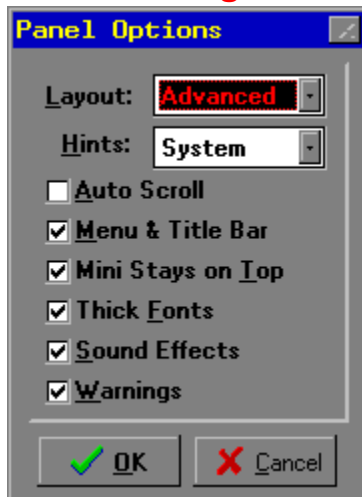
The appearance and behavior of the <u>Main Panel</u> can be adjusted from the Panel   Options entry in the Options menu. A dialog box will present you with a number of choices.

All these settings are saved in the KALKUL.KAL file when you exit the program, and loaded back when you run it again – there is no need to customize Kalkulator every time you use it.

- Layout: Advanced (the whole Main Panel shown), Basic (no Bottom Line) or Minimal (just the <u>Expression Line</u>, <u>Result Display</u> and the buttons next to it).
- Hints: System (Windows standard) or None.
- Auto   Scroll – with this option on, after a successful expression evaluation Kalkulator will scroll the Expression Line to the next expression, clearing it in the process. (The erased expression can be restored by hitting the Escape key before having entered anything again.)
- Menu & Title   Bar   –   removes or restores the <u>Menu Bar</u> and the <u>Title Bar</u>. Without the Title Bar the Main   Panel can still be moved around by click-and-dragging at its edges, and the Menu Bar functions are also available from the <u>Main Pop-up Menu</u>.
- Mini Stays on Top – when this box is checked, Kalkulator stays on top of all other windows when in the Minimal layout (see above).
- Thick Fonts   –   toggles between thin and bold fonts in numeric displays (these on the black background). If your monitor is not very sharp, then you will probably prefer bold fonts. On the other hand, thin fonts look great on active-matrix displays.
- Sound   Effects – toggles sound effects on and off.
- Warnings   –   disables or enables the program warnings. With warnings disabled, the program status file will be always saved upon exit.

See also:
   <u>Sound effects</u>

Sound effects

Kalkulator uses sound effects to denote some events. This can be turned off or on from the Panel Options dialog.

The sounds are stored as standard Windows' .WAV files in the Kalkulator home directory. The following files are included:

KALK_ERR.WAV - the sound used for errors (syntax or arithmetic)
KALK_DON.WAV - to announce a completed calculation
KALK_OK.WAV - denotes some other operations successfully completed
KALK_INP.WAV - accompanies an input box (numeric or not)
KALK_QUE.WAV - accompanies a question (Yes/No or Yes/No/Cancel)
KALK_SHO.WAV - used when one of the basic Kalkulator panels shows up

You may copy any .WAV files of your choice (renamed as above) to the Kalkulator directory; these sounds will be then used by the program.

Although the supplied sound files are rather small, you may want to save some disk space by deleting them from the Kalkulator directory. In that case it is recommended (although not required) that you turn the sounds off, as this will speed up the program operation.

Questions and Answers

If you have a question, ask. There are no stupid questions; only the answers can be.

[Can I run Kalkulator from a CD-ROM?](#)
[My registered copy does regression only to the third degree. What is wrong?](#)
[Why the sound effects do not work?](#)
[What about the Pentium bug?](#)
[How do I uninstall Kalkulator?](#)
[How do I change colors?](#)
[The button fonts look bad on my screen. What's wrong?](#)
[Some characters in this Help do not look right. Why?](#)
[Can I run two instances of Kalkulator at a time?](#)
[What are you planning for the next version?](#)

Running from CD-ROM

Yes, you can, as long as the files are not packed (zipped). You will, however, have to live with two limitations:

- You cannot save any files (Kalkulator will write only to its own directory, nowhere else)
- Trial license expiration notice will be always displayed, as if you have been using the program for more than the trial period.

And yes, you can run Kalkulator from a floppy, too.

Regression degree

To do <u>polynomial regression</u> of the n-th degree you need at least n+1 points in the <u>data buffer</u>.

Sound driver

Your computer may be lacking a sound card – this is the case if other Windows programs are also mute (although some programs may use the built-in speaker to make feeble beeps).

(A cheap way to emulate a sound card is to install Microsoft's SPEAKER.DRV. It was written for Windows 3.1, but works just fine with Windows 95 as well and can be downloaded for free. I'm using it on my Portege notebook.)

How do I uninstall Kalkulator?

Just delete the Kalkulator directory with all the files in it. The program does not put any files anywhere else.

How do I change colors?

You don't. The Kalkulator panel colors are not changed from within the program; they are bound to your desktop colors, which can be changed from the Windows Control Panel.

The graph colors, on the other hand, are currently hardwired to some preset values. If there is much of an uproar about this, I may provide a color-setting option in one of the next releases. Let me know how important you think it is.

The button fonts look bad on my screen. What's wrong?

This means that the Kalkulator fonts have not been loaded. The program should have complained about this with an error message. Make sure that the files KALKULD.FON, KALKULM.FON, KALKULP.FON and KALKULT.FON are in the Kalkulator home directory.

If no error message about missing .FON files has been shown, then obviously Windows 3.1 is running out of resources. Close as many applications as you can, then restart Kalkulator. This problem should not occur under Windows 95.

Help fonts

Your Windows installation may be using a non-US character set. While the basic characters (a..z, A..Z, 0..9) are the same in all Latin-derived character sets, the language-specific sets usually differ in what characters are used for ASCII values higher than 127.

The affected characters include those entered with special <u>keystroke combinations</u>.

The program itself is not affected by this problem, a Kalkulator (as opposed to the Windows help engine) uses its own fonts, supplied with the program.

Multiple program instances

For the 16-bit version of Kalkulator the answer is no. When you try to run another instance while the program is already running, this will be detected and the attempt will be just ignored.

For the 32-bit version: yes, as many instances as you wish (it is quite difficult to run out of system resources under Windows 95, so why not?).

What are you planning for the next version?
The next significant upgrade of Kalkulator (expected in Summer '96) will probably include a separate binary, octal and hexadecimal calculator panel. In the meantime Kalkulator will see some updates, with minor improvements and, possibly, bug fixes.

Credits and copyrights

Kalkulator is copyright © 1988-96 by J. <u>Andrzej</u>   <u>Wrotniak</u>. All rights reserved.

This software has been developed using Borland's Delphi and contains parts of code copyright © 1995-96 by Borland International.

The online help has been written with the Visual Help from WinWare, Inc.

The sound files supplied with Kalkulator have been created by Ted Tatman (thanks!) and are in public domain.

Kalkulator inherited many design ideas and a significant amount of code from two of my previous projects:

- from <u>El_Cal</u>, the Elementary Calculator for the Atari ST series (1988-94) – general concept, large parts of the user interface design
- from <u>Ex</u>, a Scientific Calculator for the HP LX Palmtop computers (1992-96) – expression parser, most of the underlying math engine

As you can see, this is not quite a new program; under various disguises it has been under development for more than seven years.

<u>Important: read the enclosed disclaimer before using the program!</u>

Disclaimer

This is what my lawyer told me to put here:

Kalkulator is licensed on the "as is" basis.

Although the author has extensively tested the software and reviewed the documentation, he makes no warrant or representation, explicit or implied, with respect to this package, its quality, performance, merchantability or fitness for a particular purpose, in any hardware or software environment.

In no event shall the author be liable for direct, indirect, special, incidental or consequential damages arising out of use, misuse or inability to use the software or documentation.

In addition, drinking excessive amounts of coffee when using this program may lead to insomnia, headaches and loss of facial hair.

Agnieszka

Ten program jest dla Agnieszki.

Agnieszka jest nieduza i w okularach. Chyba, ze sie jej zdejmie, ale juz jak zdjac, to wszystko.

Z Agnieszka dobrze sie smiac, dokuczac jej troszke, walesac sie po Pieninach albo w Dolinie Ognia (szczegolnie latem), kapac sie z meduzami na Tangier Island, walczyc z krabem w bulce, miec znajomego konia na Placu Zamkowym, bobrowac w lodowce o trzeciej nad ranem, namydlac sie w wannie (bo bardzo higieniczna jest ta Agnieszka!) i duzo wiecej.

Czasem jest Agnieszka troszke smutna -- i wtedy trzeba cos szybko zrobic, bo tyle dobrego sie marnuje.

Dobrze, ze sobie te Agnieszke znalazlem. Przyda sie.

The [Clear] button clears the buffer. The data is lost.

Clicking on [Delete] (or pressing the Delete key) will remove the selected data point from the buffer (in the XY mode both the X and Y value will be deleted).

The [Exit] button (or pressing Escape) closes the Data   Editor window and returns to the Main   Panel. You do not have to do this, as the Data   Editor window is non-modal, i.e. it can remain open while the Main   Panel is being accessed.

This button, accessible only in the registered copies of Kalkulator, allows to save the buffer contents to a plain text (ASCII) file or to read the buffer from such file.

This button changes the data display format between fixed-point and exponential. The third, "default" option uses the format depending on the displayed value; it also drops the trailing zeros from the display.

Data Grid

You can view and edit the contents of the <u>Data Buffer</u> here. In the XY mode, the left column shows x-values, the right one -- y-values. One of the data points will be always selected (highlighted).

Clicking on the [Insert] button (or pressing the Insert key) will insert a new data point before the selected one.

This field shows the index of the selected data point, as well as the current number of points in the buffer.

The [Mode] button toggles between X and XY modes

Clicking on [Purge] will delete all <u>bad data</u> points from the buffer.

The [Size] button will set the number of data points in the buffer to a new value (within the buffer maximum size).
If the new number is smaller than the current one, the points at the end will be discarded. If it is larger, then new <u>bad data</u> points will be appended at the end.

Clicking on [Sort] will sort the data points in the increasing sequence of x- or y-values.

The [Swap] button (available in the XY mode only) will swap the x- and y- values in the buffer.

Clicking on [Undo] (if it is enabled at the moment) will insert the last deleted data point back into the buffer.

Direct orders by mail

This is very simple: send a check or a money order for $40 (U.S. currency, drawn on a U.S. bank) to my mail address:

Dr. J. Andrzej Wrotniak
2057 Happy Lane
Crofton, MD 21114-1917
U.S.A.

(Sending cash is not recommended, although, of course, I will not refuse accepting it.)

Include your name and address, also your email address, if applicable. I will use the latter to email you the Kalkulator registration key and the information how to download the most recent version from CompuServe, AOL or World Wide Web.

Otherwise, I will ship you a floppy disk with the key and the newest version of Kalkulator. If you do not state what Windows you're running, I'll include both the 16- and 32-bit program.

(If you put a sentence or two about what you are using Kalkulator for, it will be very much appreciated. It is easier to develop a program knowing who is using it.)

Ordering directly from me, you may be able to use one of the <u>available discounts</u>. You may also get the <u>Mighty Midget</u> for just an extra $5, hard to resist. Please state clearly if the name on Midget registration has to be different than yours.

See also:
<u>Other ways to register</u>

Discounts available

Here are the special prices for some categories of users:

- Full-time students   – $30. Please enclose a proof (e.g., a copy of a school ID) with order.
- Registered users of Ex or Spheric on the HP Palmtop/ PC-DOS platform, and of El_Cal or Star Base on the Atari ST   – $30.
- Registered users of the Mighty Midget for Windows – $35 (you may also register both at the same time for just $45).

  These discounted prices are applicable only to orders sent to my address by mail and paid by check, cash or money order in US$.

[Edit] activates the Vector and Matrix Editor, used to view or modify the values of vectors and matrices.

Press this button to back up one step.

Clicking on [Clr] will clear the displayed operation.

The operation you are entering is shown here. After the result is computed, the display will become dimmed.

Press [=] to select vector, matrix or scalar to store the operation result.

Clicking on the [File] button allows to write all vectors and matrix objects to a text file, or to read them from such file. This feature is available only in registered copies of Kalkulator.

Click on [OK] to close the Linear   Algebra Panel. As the panel is non-modal, you do not have to close it in order to access other parts of Kalkulator.

Linear algebra operands

These buttons are used to enter operands of linear algebra operations: vectors, matrices, and scalars.
The scalars are represented by Kalkulator <u>variables</u>, chosen from a pop-up menu.

Linear algebra operator buttons

The buttons in this group are used to enter linear algebra operators. To avoid syntax errors, only the buttons corresponding to legal (in the current context) entries are enabled at any given moment.

This button allows to change the size of vectors and matrices used in linear algebra operations (they will be cleared in the process, with all elements set to zero).

The Mighty Midget

For those who do not need the most advanced features of Kalkulator (or for friends and relatives of Kalkulator users), there is a simpler alternative: the Midget.

```
2.55/2π-sin 20°33'+(1-exp X)²|
Conv  Form        12.17697923890352        F  V  Rad  1  ?
```
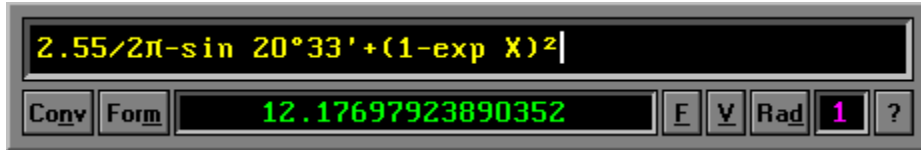
Midget may be used as a handy replacement for the calculator included with Windows (3.1, 95 or NT).

What Midget does is to evaluate expressions (using the same powerful internal engine and providing the same accuracy as Kalkulator). It also has built-in unit   conversion. Using it is a no-brainer.Just type in what you want to compute and hit Enter.

Midget is a $10 shareware. You can download an evaluation copy from the CompuServe (the Science forum, Math Library), America Online, or from my Web page.

The Bottom Line

This is a row of buttons for accessing some of the advanced operations. The buttons at the left access the underline numerical operations, the buttons in the middle are used for underline statistical operations on the data   buffer, and the buttons on the right – for function plotting.

The Bottom   Line can be hidden by using the [Options|Advanced operations] menu entry and restored in the same way.

This is a mouse equivalent of the Backspace key (for keyboard-phobes only).

[Clr] clears the <u>Expression Line</u> (the current expression only). Pressing the Escape key does the same.

Click here to access predefined <u>physical constants</u> (via a pop-up menu). The value of the selected constant will be shown in the Result Display.

Click on [Convert] to recompute the value shown in the <u>Result Display</u> from one unit of measurement to another.

The Digit Panel

This panel, in addition to digit buttons, contains the decimal point and exponent,   the constants: pi and Euler's e, and the button for accessing <u>physical constants</u>.

Click on [=] to select a variable via a pop-up menu. The contents of the <u>Expression Line</u> is then computed, and the result stored in that variable (also shown in the Result Display).

The Expression Line

This is where the expression you are entering is being shown. The maximum expression length is 60 characters (120 in the registered version). The arrows at the right move between different expressions, and the current expression number is shown next to them.

This button is used to change the format of the Result Display (fixed-point, exponential, deg/min/sec etc.). The displayed value itself does not change.

The Function Panel

This panel contains buttons used to enter function names into expressions. It has four pages, selectable with the tabs at the panel top:

Standard Function Page

Statistical Function Page

User Function Page

Extra Function Page

Standard Function Page

See also:
[Standard functions](#)

Statistical Function Page

Stand	Stat	User	**Extra**

min	max	ifn	ifz	ifp
avg	mxa	ft	lb	hrs
gav	hav	x#	y#	poly

a#	b#	c#	u#	v#	w#

See also:

- Statistical distribution functions
- Random number generators
- Euler and related functions

User Function Page

The number of the current expression line is shown here, and the arrow buttons allow to move to the next or the previous one. Clicking on the number itself will take you to Line 1.

The Menu Bar

This is a regular Windows menu   bar. Some less frequently used operations are accessible from here, see Menu Operations.

You may hide the Menu   Bar (and the Title Bar) by unchecking the "Menu & Title   Bar" option in the Panel Options dialog, accessible from the Options menu.

When the Menu   Bar is hidden, its functions are accessible from the Main Pop-up Menu (press F10 or click the right mouse button over the edge of the Main   Panel).

The Operator Panel

This panel contains the buttons for common arithmetic operators. It also includes the parentheses and the comma (used to separate multiple function arguments), and the buttons for entering degrees, minutes and seconds of angle.

This button toggles between the Radian and Degree <u>angular mode</u>.

The Result Display

Here the result of the last operation is shown. This result can be reformatted to a another representation or precision with use of the [Format] button, or converted between different measurement units with use of [Convert].

By clicking on this button you can enter the <u>Temporary Variable</u>, t, into expressions.

The Title Bar

This is a regular Windows title bar. You may use it to move the Main Panel around.

To save the screen space, you may hide the Title Bar (and the Menu Bar) by clicking on the [Options | Panel Options] menu entry. Use the same entry (obviously, from the pop-up menu this time) to revert the change.

When the Title Bar is hidden, you may still drag the Main Panel around the screen by pressing and holding the mouse at the panel edge (the cursor changes to signal that you are there). The same applies to the Data Editor and Linear Algebra Panel.

To minimize Kalkulator when the Title Bar is not visible, click in the top left corner of the Main Panel (the cursor will change into an up-arrow when you find the place).

The Variable Panel

This panel allows to access and review Kalkulator variables and statistical parameters of the data in the buffer.
It has three pages, selectable with the tabs at the panel top:

Variable Button Page
Browser Page
Parameter Page

Credit card orders by phone or fax

Public Software Library, a long-time, respectable shareware distributor from Texas, processes Kalkulator credit card orders received by phone or fax (the latter makes sense from overseas!). Phone orders are accepted from Monday to Thursday from 7:00 a.m. to 6:00 p.m, Friday from 7:00 a.m. to 12:30 p.m.

   Voice: 800-2424-775 or 713-524-6394
   Fax: 713-524-6398

State the product name and number: Kalkulator, #14667.

Please note: these phone numbers are for credit card orders only!

Do NOT use these numbers to get technical support or to check the status of your order (assuming such a need arises), or availability of the newest version. PsL handles only the money side of the transaction, passing your order to me within 24 hours; from that moment I'm your only point of contact (and a willing one, too). They are not prepared to handle any other questions or problems.

Visa, Master Card and American Express are accepted; your account will be charged $40 in the U.S. currency. Do not forget to include your address, card number and expiration date.

If applicable, also include your email address which I prefer to use to supply you with your registration key. If you would rather prefer to have a floppy disk shipped to you, please state so.

Do not send me your credit card number; I cannot forward it to PsL. To stay in line with the bank requirements, PsL has to receive your order directly from you.

See also:
   Other ways to register

Credit card orders via mail

If you live outside of the United States, you may choose to order by mail with your credit card (Visa, Master Card, American Express).

Send your order to

Public Software Library Registration Service
P.O.Box 35705
Houston, TX 77235-5705
USA

Please include your name, shipping address, billing address (if different), card number, expiration date, phone number and your signature. The price of $40 includes everything.

If you have an email address, please provide it, too. I will use it to send you the registration key. Otherwise I will mail you a floppy disk (with both 16- and 32-bit versions of Kalkulator included).

Upon receipt of your order PsL notifies me via email within less than 24 hours, and from that moment on I handle your order.

As PsL handles only the monetary aspect of the registration, do not try to contact them for technical support, product availability or order status information. For these purposes use <u>my address</u> or, better, <u>my email address</u>.

See also:
   <u>Other ways to register</u>

Registering on World Wide Web

The easiest way to do register with use of a VISA, Master Card or American Express on the World Wide Web, is to follow the link provided on the Kalkulator page. To go to the Kalkulator distribution site, set your browser to

http://www.freeflight.com/wrotniak/kalkul.html

and when already there, click on the PsL registration link. This will take you to the Public Software Library Electronic Registration Service in Texas (small world!), directly to the Kalkulator order form. The PsL folks did everything to make your transaction secure.

Public Software Library provides registration services for more than 1000 shareware authors; you may have a look at other offerings there.

PsL only processes the money side of the transaction, therefore use their link only to order; all technical correspondence and inquires (if any) about the order status should be sent to my email address.

See also:
   Other ways to register

Registration on the CompuServe

Members of the CompuServe can register Kalkulator on-line.

To register, GO SWREG at any prompt (or click on the traffic light icon at the top of your WinCIM screen and type SWREG), then follow the directions. The registration numbers are

- For the 16-bit version: #8743, file name -- KALKUL.ZIP
- For the 32-bit version: #10794, file KALK16.ZIP

The registration fee of $40 will be included into your next CompuServe bill.

(Registering either version of Kalkulator covers both; the distinction is purely for bookkeeping purposes.)

Please note that none of the discounts mentioned elsewhere in this document are available when registering this way.

See also:
   Other ways to register

The polynomial equation

This field shows the form of the polynomial equation whose roots will be found by clicking on [Solve].

The [Exit] button (or pressing Escape) closes the Root   Panel
and returns to the Main   Panel.

Polynomial coefficients

The real coefficients c0..c4 of a polynomial equation are entered here.
Any legal Kalkulator expression is accepted.

Solution display

The values of computed roots (or their real and imaginary parts) are shown here. Clicking the left mouse button allows to store the selected value in one of the Kalkulator <u>variables</u>; the right button is used to view the selected value with full accuracy.

When the [Solve] button is clicked upon, the roots of the current equation are computed and displayed.

a#

a#(i,j)   returns the value of the (i,j)-th element of matrix a,
where i is the row, and j - the column.

a0...a9
Polynomial regression coefficients

abs

abs x   computes the absolute value of x.

acos

acos x   computes an arc cosine of x.

acosh

acosh x   computes an inverse hyperbolic cosine of x.

acot

acot x   computes an arc cotangent of x.

acoth

acoth x   computes an inverse hyperbolic cotangent of x.

agau

agau(x,m,s)   returns the integral from m-(x-m) to x of the Gaussian
(Normal) distribution with mean m and standard deviation s.

Andrzej
Pronounced "Un-Jay"

ang

ang(x,y)   computes the polar angle of a Cartesian point (x,y), i.e. the angle between the x-axis and the line from (0,0) to (x,y).

asin

asin x   computes an arc sine of x.

asinh

asinh x   computes an inverse hyperbolic sine of x

astu

astu(x,r)   returns the integral from -x to x of the t (Student) distribution with r degrees of freedom.

atan

atan x   computes an arc tangent of x.

atanh

atanh x   computes an inverse hyperbolic tangent of x.

avg

avg(x,y)   computes the average of x and y: (x+y)/2

b#

b#(i,j)   returns the value of the (i,j)-th element of matrix b,
where i is the row, and j - the column.

Bad data

When points in the Data Buffer are being computed, some of them may end up without values assigned, because of computation errors. These points will be flagged as bad data, denoted in the Data Editor as "?".

This is also how the new points, created when the number of points in the buffer is being changed to a larger value, are marked.

bet

bet(x,y)   computes the Euler Beta function of x and y, defined as Gamma(x)*Gamma(y)/Gamma(x+y)

Beta distribution

Density: fbet(x,a,b) for 0<=x<=1 and parameters a>0 and b>0.

Binomial distribution

Probability: fbin(x,n,p) for 0<=x<=n and 0<p<1 where n is the total number of tries and p is the probability of a success in a single try.

c#

c#(i,j)   returns the value of the (i,j)-th element of matrix c, where i is the row, and j - the column.

Central distribution integral

The integral from m-(x-m) to x of f(x), i.e. the probability that the random variate will assume a value as close to the distribution center, m, as x or closer. For m=0 this means just between -x and x.

Chi-square distribution

Density: fchi(x,r), for x>=0 and r>0 degrees of freedom.

com

com(n,k)   computes the combinations of n by k, i.e. n!/[k!(n-k)!],
where n and k do not have to be integers

cos

cos x   computes a cosine of x

cosh

cosh x   computes a hyperbolic cosine of x.

cot

cot x   computes a cotangent of x

coth

coth x   computes a hyperbolic cotangent of x.

cu

cu x   computes a cube (third power) of x.

cur

cur x   computes a cubic root of x.

cv

The covariance of x and y in the Data Buffer

Data Buffer

This is where Kalkulator stores the data points submitted to statistical operations. The capacity of the buffer is 128 single-value points (in the X mode) or 64 value pairs (XY mode); in the registered copies these limits are raised to 6400 and 3200, respectively.

Distribution density

Sometimes referred to as differential distribution function: $f(x) = dP(x)/dx$.

El_Cal

The final Version 2.40 (a maintenance release) is available to all registered owners for free -- just send a self-addressed, stamped envelope and a formatted DD diskette, or $5, to my address as shown in this Help.

Ex

The current version 1.5 (includes linear algebra) is available for $30. Works on HP 95/100/200 LX. Evaluation copy can be downloaded from the CompuServe (go HPHAND, Lib.7) or from my personal Web page. One of the top CIS Palmtop Forum downloads.

exp

exp x   computes Euler's e to the power of x

F (Snedecor) distribution

Density: fsne(x,r,s) for x>=0 and for r and s degrees of freedom.

Factorial

Usually defined, for integer arguments only, as n!=1*2*...*n. Kalkulator will compute it for non-integer arguments as well, using the Gamma function: n!=gam(n+1). For integer arguments both definitions are equivalent.

fbet

fbet(x,a,b)   returns the distribution density at x for a beta distribution with parameters a and b.

fbin

fbin(x,n,q)   returns the distribution probability at x (integer) for a binomial distribution with parameters n (no. of tries) and q (single-try success probability).

fchi

fchi(x,r)   returns the distribution density at x for a chi-square distribution with r degrees of freedom.

fgam

fgam(x,a)   returns the distribution density at x for a gamma distribution with the parameter a.

fgau

fgau(x,m,s)   returns the distribution density at x for a Gaussian (Normal) distribution with mean m and standard deviation s.

fpoi

fpoi(x,m)   returns the distribution probability at x (integer) for a Poisson distribution with a mean value m.

fra

fra x   computes the fractional part of x. For negative x, fra(x) will also be negative.

fsne

fsne(x,r,s)   returns the distribution density at x for an F (Snedecor) distribution with r and s degrees of freedom.

fstu

fstu(x,r)   returns the distribution density at x for a t (Student) distributions with r degrees of freedom.

ft

ft(x,y)   converts x feet and y inches into feet, as x+y/12

gam

gam x   returns the Euler gamma function of x, for positive and non-integer negative arguments

Gamma distribution
Density: f(x,a) for x>=0 and for the parameter a>0.

gav

gav(x,y)   computes the geometric average of x and y: sqrt(xy)

Handbook of Mathematical Functions

Abramowitz and Stegun, National Bureau of Standards.

hav

hav(x,y)   computes the harmonic average of x and y: 2/(1/x+1/y)

hrs

hrs(x,y,z)   converts x hours, y minutes and z seconds into hours, as x+y/60+z/3600

iagau

iagau(p,m,s)　　finds a value of x, for which agau(x,m,s)=p, for a Gaussian (Normal) distribution with mean value m and standard deviation s.

iastu

iastu(p,r)   finds a value of x, for which astu(x,r)=p, for a t (Student) distribution with r degrees of freedom.

ifn

ifn(x,y,z)   returns y if x<0, otherwise z.

ifp

ifp(x,y,z)　　returns y if x>0, otherwise z.

ifz
ifz(x,y,z)   returns y if x=0, otherwise z

Implied multiplication

The "*" operator can often be skipped, as in "3 sin 2X". Kalkulator will then insert the implied multiplication operator, denoting it with a "·" if it makes the expression more readable -- here in one of two cases: "3·sin 2X". The implied multiplication has a higher priority than "*".

int

int x   computes the integer part of x (rounded towards zero).

Inverse integral distribution

More precisely: a function inverse to a cumulative (integral) distribution function. These functions compute a random variate value corresponding to a given probability integral.

For example, while the prefix "p" in the distribution function name means "find the integral probability for a given value of the random variate", the "ip" prefix means "find the random variate value for which the integral probability is such and such".

ipbet

ipbet(p,a,b)   finds a value of x, for which pbet(x,a,b)=p, for a beta distribution with parameters a and b.

ipbin

ipbin(p,n,q)   finds a value of x, for which pbin(x,n,q)=p, for a binomial distribution with parameters n and q.

ipchi

ipchi(p,r)   finds a value of x, for which pchi(x,r)=p, for a chi-square distribution with r degrees of freedom.

ipgam

ipgam(p,a)   finds a value of x, for which pgam(x,a)=p, for a gamma distribution with parameter a.

ipgau

ipgau(p,m,s)   finds a value of x, for which pgau(x,m,s)=p, for a Gaussian (Normal) distribution with mean value m and standard deviation s.

ippoi

ippoi(p,m)   finds a value of x, for which ppoi(x,m)=p, for a Poisson distribution with mean value m.

ipsne

ipsne(p,r,s)   finds a value of x, for which psne(x,r,s)=p, for an F (Snedecor) distribution with r and s degrees of freedom.

ipstu

ipstu(p,r)   finds a value of x, for which pstu(x,r)=p, for a t (Student) distribution with r degrees of freedom.

iqbet

iqbet(p,a,b)   finds a value of x, for which qbet(x,a,b)=p, for a beta distribution with parameters a and b.

iqbin

iqbin(p,n,q)   finds a value of x, for which qbin(x,n,q)=p, for a binomial distribution with parameters n and q.

iqchi

iqchi(p,r)   finds a value of x, for which qchi(x,r)=p, for a chi-square distribution with t degrees of freedom.

iqgam

iqgam(p,a)   finds a value of x, for which qgam(x,a)=p, for a gamma distribution with parameter a.

iqgau

iqgau(p,m,s)   finds a value of x, for which qgau(x,m,s)=p, for a Gaussian (Normal) distribution with mean value m and standard deviation s.

iqpoi

iqpoi(p,m)   finds a value of x, for which qpoi(x,m)=p, for a Poisson distribution with mean value m.

iqsne

iqsne(p,r,s)   finds a value of x, for which qsne(x,r,s)=p, for an F (Snedecor) distribution with r and s degrees of freedom.

iqstu

iqstu(p,r)   finds a value of x, for which qstu(x,r)=p, for a t (Student) distribution with r degrees of freedom.

KALKUL.KEY

This is your personal registration file; it will be recognized by Kalkulator, making its enhanced features available. Copy this file to the same directory where Kalkulator is; also make a safe backup.

Whenever you get (download, steal, borrow) a new version of Kalkulator, remember to put KALKUL.KEY together with the other files. The key file currently distributed will work with all future versions of Kalkulator up to 1.99.

Kalkulator

About the name: this is not a "Kountry Kitchen" trying-to-be-cute stuff.
Kalkulator (pronounced: "Cal-coo-lah-tor") is a legitimate Polish word;
it can be translated into modern American English as "The Mother of
All Calculators and There Ain't No Better One, Period, No Kidding".

Keystroke combinations

Ctrl-d   enters the degree symbol, °

Ctrl-e   enters the Euler's e, shown as é

Ctrl-p   enters pi, ¶

Ctrl-2   enters the square, ²

Ctrl-3   enters the cube, ³

lb

lb(x,y)   converts x pounds and y ounces into pounds, as x+y/16

Left distribution integral

Also called a cumulative distribution function, P(x). This is an integral up to x from f(x), i.e. the probability that the random variate will assume a value less than or equal to x.

lgb

lgb x   computes a binary (base 2) logarithm of x

lgm

lgm x   computes a natural logarithm of Gamma of x

lgm

lgm x   computes a natural logarithm of the Euler Gamma function of x

ln

ln x   computes a natural (base e) logarithm of x

log

log x   computes a decimal (base 10) logarithm of x

Main Pop-up Menu

This menu pops up when you press the right mouse button over the Main Panel edge. It provides all functionality of the Kalkulator's Menu Bar, at the same time saving screen space.

max

max(x,y)   computes the larger value of x and y.

min

min(x,y)   computes the smaller value of x and y

mod

mod(x,y)   computes the remainder of the division of x by y.

mx

Mean value of x in the Data Buffer

mxa

mxa(x,y)   chooses the argument with the greater absolute value

My Address

Dr. J. Andrzej Wrotniak
2057 Happy Lane   (I'm not kidding!)
Crofton, MD 21114-1917
USA

My email address
CompuServe: 70611,2552
Internet: 70611.2552@compuserve.com

my

Mean value of y in the Data Buffer

Nagging Screen

Kalkulator will not stop working after the trial license expires. It will just display, at the program startup, the screen with licensing information, urging the reluctant (or thrifty) user to make the choice between registering the program or removing it from his/her system.

nn
Number of points in the Data Buffer.

Normal (Gaussian) distribution

Density: fgau(x,m,s), where m is the mean value   and s>0 -- the standard deviation.

pbet

pbet(x,a,b)   returns the integral from 0 to x of the Beta distribution with parameters a and b. It is equivalent to the incomplete Beta function ibet(a,b,x).

pbin

pbin(x,n,q)   returns the probability sum between 0 and x (integer) for a binomial distribution with parameteres n and q.

pchi

pchi(x,r)   returns the integral from 0 to x of the chi-square distribution with r degrees of freedom.

pgam

pgam(x,a)   returns the integral from 0 to x of the Gamma distribution with the distribution parameter a.
It is equivalent to incomplete Gamma function igam(a,x).

pgau

pgau(x,m,s)   returns the integral from minus infinity   to x of the Gaussian (Normal) distribution with mean m and standard deviation s.

Poisson distribution

Probability: fpoi(x,m) for x>=0 and mean m>0.

poly

poly(x)   computes a polynomial of x, with coefficients given by data buffer parameters a0, a1... etc.

Power operator

This operator, shown as "^", raises the first operand to the power of the second, as in "x^y" (x to y). If y is not integer, then x has to be greater than zero.

ppoi

ppoi(x,m)   returns the probability sum from 0 to x (integer)   of the Poisson distribution with the mean value m.

psne

psne(x,r,s)   returns the integral from 0 to x of the F (Snedecor) distribution with r and s degrees of freedom

pstu

pstu(x,r)   returns the integral from minus infinity to x of the t (Student) distribution with r degrees of freedom.

qbet

qbet(x,a,b)   returns the integral from x to 1 of the Beta distribution with parameters a and b.

qbin

qbin(x,n,q)   returns the probability sum between x+1 (integer) and n, for a binomial distribution with parameteres n and q.

qchi

qchi(x,r)   returns the integral from x to infinity of the chi-square distribution with r degrees of freedom.

qgam

qgam(x,a)   returns the integral from x to infinity of the Gamma distribution with the distribution parameter a.

qgau

qgau(x,m,s) returns the integral from x to infinity of the Gaussian (Normal) distribution with mean m and standard deviation s.

qpoi

qpoi(x,m)   returns the probability sum from x+1 (integer) to infinity of the Poisson distribution with the mean value m.

qsne

qsne(x,r,s)   returns the integral from x to infinity of the F (Snedecor) distribution with r and s degrees of freedom.

qstu

qstu(x,r)   returns the integral from x to infinity of the t (Student) distribution with r degrees of freedom.

rad

rad(x,y)   computes the polar radius of the Cartesian point (x,y), i.e. the distance from (0,0) to (x,y).

ran

ran x   returns a random value from a uniform distribution between 0 and x.

rcp

rcp x   computes reciprocal of x, i.e. 1/x

Regression coefficients

Variables a0, a1 ... a9 (depending on the degree), computed for the XY data buffer with use of the [Regr] button.

rgau

rgau(m,s)   returns a random value from a Gaussian (Normal) distribution with mean m and standard deviation s.

Right distribution integral

The integral of f(x) from x up, or the probability that the random variate will assume a value greater than x. Note that Q(x)=1-P(x).

rou

rou(x,y)   rounds x to the nearest whole multiple of y.

rpoi

rpoi m   returns a random value (integer) from a Poisson
distribution with a mean value m.

sgn

sgn x   returns the sign of x: -1 for negative, 1 for positive and 0 for x=0.

sin

sin x   computes a sine of x

sinh

sinh x   computes a hyperbolic sine of x.

Site licenses

Site licenses are priced at $100 plus $15 per user (e.g., for 20 users $100 + 20 * $15 = $400. We will invoice institutions within the U.S. Obtaining a site license will allow your company to avoid problems in case of a software audit.

sq
sq x computes a square (second power) of x

sqr

sqr x   computes a square root of x

sx

Standard deviation of x in the Data Buffer

sy

Standard deviation of y in the Data Buffer

t (Student) distribution

Density: fstu(x,r) for r degrees of freedom.

tan

tan x   computes a tangent of x

tanh

tanh x   computes a hyperbolic tangent of x.

Temporary Variable

Denoted as t, this variable is used to store the result of the last operation, shown in the Result Display. Even if the result is explicitly stored in another variable (A..Z), it will be stored in t as well.

ten

ten x   computes 10 to the power of x

two

two x   computes two to the power of x

u#

u#i   returns the value of the i-th element of vector u.

v#

v#i   returns the value of the i-th element of vector v.

vx

Variance of x in the Data Buffer

vy
Variance of y in the Data Buffer

w#

w#i   returns the value of the i-th element of vector w.

Wrotniak

Ex-physicist, formerly specializing in computer Monte Carlo techniques applied to cosmic ray physics. Taught physics and computer science at University of Lodz, Poland. In the U.S. since 1984, makes his life as a software engineer. Currently the Chief Scientist at Aerospace Engineering & Research in MD, helping to bring the air traffic control software out of its 19th century state. One day may get a real job and a haircut.

x#

x#i   returns the i-th x-value from the Data Buffer.

x1

The smallest value of x in the Data Buffer

x2

The largest value of x in the Data Buffer

y#

y#i   returns the i-th y-value from the Data Buffer in the XY mode.

y1

The smallest value of y in the Data Buffer

y2

The largest value of y in the Data Buffer