Manual

Perpenso® Calc v1.5.1
Perpenso® Calc 4 v4.5.1

November 6, 2012
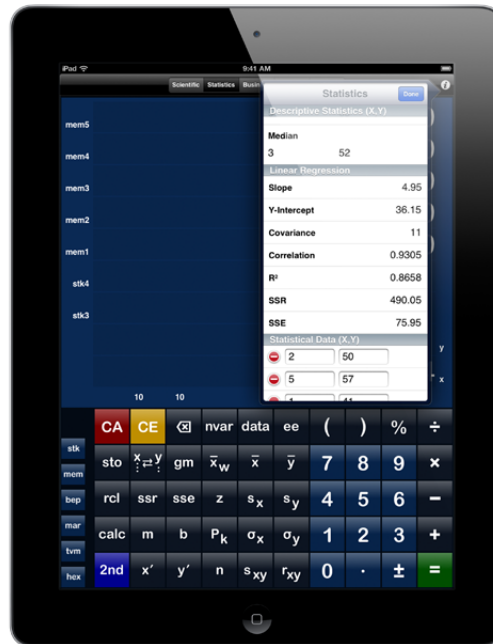

Scientific
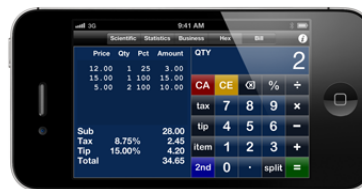

Statistics

Business

Worksheets

Hex

Bill / Tip

NOTICE

THIS MANUAL AND ANY EXAMPLES CONTAINED HEREIN ARE PROVIDED "AS IS" AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. PERPENSO LLC MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MANUAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT AND FITNESS FOR A PARTICULAR PURPOSE.

PERPENSO LLC SHALL NOT BE LIABLE FOR ANY ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, PERFORMANCE, OR USE OF THIS MANUAL OR THE EXAMPLES CONTAINED HEREIN.

Perpenso Calc is a paid app and Perpenso Calc 4 is a lite app that is upgradable via In App Purchases. Graphics and text throughout this manual describes Perpenso Calc. Reminders that functionality or features are unavailable in Perpenso Calc 4 without upgrades may or may not be present.

Table Of Contents

Contacting Perpenso LLC

To offer suggestions or to receive technical support please email
support@perpenso.com. Before doing so please check the Frequently Asked
Questions online at http://www.perpenso.com/calc/faq.html, your answer may be a
couple of clicks away.

Introduction

Perpenso® Calc is an application for the Apple® iPhone®, iPad® and iPod touch®. It is five calculators in one: scientific, statistics, business/finance, hex and bill/tip. All five calculator modes are included, there are no longer any optional modes. Perpenso Calc also includes a calculator tape, worksheets and a built-in manual.

Copy and paste are supported and are convenient ways to transfer data to and from other applications such as Notes and Mail. The numeric value may be a decimal number, a fraction or a complex number in cartesian or polar form.

Perpenso Calc 4 is a related upgradable lite app. Scientific mode is included and the other modes are optional. Lite mode differs from full mode in the following ways:
- It is ad supported
- iPhone: Buttons are slightly reduced in size to make room for ads
- Features/Functionality not available in lite mode:
  The calculator tape
  RPN entry
  Color schemes
  iPad: User definable display lines

Future features and functionality added to Perpenso Calc 4 may not be available without upgrades.

The current calculator mode is selected using the segmented control on the calculator navigation bar. These modes are not exclusive. No data is lost as modes are changed. Operations from different modes may be combined.

In scientific mode Perpenso Calc is a feature rich calculator that is comparable to traditional handheld calculators. It provides:

- 72 operations (43 complex number)
- Optional RPN entry (except in lite mode)
- Decimal based arithmetic (no binary rounding)
- 20 digit precision (enough for 64-bit arithmetic)
- 10 memory registers
- Fractions
- Complex numbers, cartesian (rectangular) and polar
- 2D rotation
- Scientific and engineering notation
- Unit and time conversions

Perpenso Calc's statistics mode includes:

- 42 operations
- Optional worksheet for data entry/editing and viewing common statistics
- Importing data from the web
- Single and two variable data
- Descriptive statistics
- Linear regression
- Probabilities

While the button based interface of a traditional handheld calculator works well for many things it is awkward for some tasks. Editing data is one such task. Fortunately iOS provides a modern and powerful graphical interface.

Screen 1 — Statistics

Statistics   Done

Descriptive Statistics (X,Y)

Observations
10

Mean
3   51

Sample Standard Deviation
1.4907   7.9303

Population Standard Deviation
1.4142   7.5233

Minimum
1   38

Screen 2 — Statistics

Statistics   Done

Linear Regression

Slope	4.95
Y-Intercept	36.15
Covariance	11
Correlation	0.9305
R²	0.8658
SSR	490.05
SSE	75.95

Statistical Data (X,Y)

⊝ 2   50

Screen 3 — Statistics

Statistics   Done

Statistical Data (X,Y)

	X	Y
⊝	1	41
⊝	3	54
⊝	4	54
⊝	1	38
⊝	5	63
⊝	3	48
⊝	4	59
⊝	2	46

⊕ new data

Worksheets offer a more natural way to enter, edit and view data and to perform some common calculations. In the statistics worksheet data may be entered and edited in a table. Above this table descriptive statistics such as mean and standard deviation are automatically displayed. In two variable mode a linear regression is also automatically displayed.

In business mode Perpenso Calc offers:

- 53 operations
- Optional worksheets for data entry/editing and performing common calculations
- Breakeven point
- Profit margin
- Time value of money
- Amortization
- Cash flows
- Interest rate conversion
- Running total

Worksheets offer a more natural way to enter, edit and view data and to perform some common calculations. The business worksheets offer breakeven point, profit margin, time value of money, amortization and cash flow functionality.

In breakeven calculations you can set any four of the five variables and calculate the fifth. If profit is set to zero then the calculated quantity is the breakeven point.

Profit margin calculations are a little more restrictive than breakeven calculations. In general a particular pair of variables is set in order to calculate the desired value. For example to calculate price and margin first enter the cost and markup, calculate the price and then calculate the margin.

Time Value of Money (TVM) calculations can solve a wide range of problems. Loans, mortgages, leases, savings, annuities, etc. There are five key variables: number of payment periods, interest per year, present value, periodic payment and future value. Set any four of these variables and the fifth may be calculated. There are also a few prerequisite variables that must be set appropriately: payments per year, interest compoundings per year and payment timing (beginning or end of period).

Once a TVM calculation has been performed the amortization worksheet may be used to see how the remaining balance, principal payments and interest payments change over time. You can also see the amount of interest and principal paid over the life of the loan or during a specific period of time.

In the cash flow worksheet cash flows may be entered and edited in a table. Above this table various prerequisite variable are displayed and may be edited. At the top of the worksheet traditional measurements such as net present value, internal rate of return, payback, etc are automatically calculated and displayed.

In hex mode Perpenso Calc is a valuable tool for programmers. It offers:

- 43 operations
- Optional worksheets for data entry/editing and performing common conversions
- Decimal, hex, octal and binary
- 64-bit and 32-bit modes
- Unsigned and signed modes
- Bitwise, shift and rotate operators
- Bit set and clear
- Byte swapping
- UTF-8, UTF-16 and UTF-32 encoding, decoding and conversions
- IEEE single and double precision floating point encoding and decoding
- Dotted quad encoding
- RGBA decoding with a preview of the color

Hex Done

Conversion

Unsigned | Signed | 64 bit | 32 bit

Decimal 18,446,744,073,709,551,230

Hex FFFF FFFF FFFF FE7E

Octal 1777777777777777777176

Binary 11111111 11111111
11111111 11111111
11111111 11111111
11111110 01111110

UTF-8

3G 9:41 AM

Unicode Done

Characters

Text €

Coded character sequences (hex)

UTF-8 E2 82 AC

UTF-16 20AC

UTF-32 000020AC

The hex worksheet provides various fields showing how a value may be represented. Edit a value in either the decimal, hex, octal or binary field and the other three fields are automatically updated. An additional UTF-8 field will display a string of characters if the value is a valid UTF-8 encoding. You may also reinterpret values as signed or unsigned or as 64-bit or 32-bit.

In the unicode worksheet you may enter characters in the text field and the various UTF encodings will be automatically displayed. Hex values may be edited in either the UTF-8, UTF-16 or UTF-32 fields and the other fields are automatically updated.

In bill mode Perpenso Calc easily determines the portion of a bill that you are responsible for and an appropriate tip. It allows you to:

- Add items to a scrollable list
- Set item quantity
- Set the percentage of an item that you are responsible for
- Set tax and tip percentage
- Set tax and tip amount
- Split the total
- Send itemized bill to calculator tape (except in lite mode)
- Enter/edit items using a worksheet

The left half of the screen displays a list of items, subtotal, tax, tip, total, etc. The item list always has a column showing the final amount for each item. There are also optional columns showing the price, quantity and the percentage you are responsible for. To enhance readability the optional columns are only shown if they contain non-default values. The default quantity is 1 and the default percentage is 100%. The list scrolls up and down using flicking gestures.

Price	Qty	%	Amount
12.00	1	25	3.00
15.00	1	100	15.00
5.00	2	100	10.00

Sub			28.00
Tax	8.75%		2.45
Tip	15.00%		4.20
Total			34.65
Split	1		34.65

Optionally specifying the percentage of an individual item that you are responsible for provides functionality that simply splitting the total does not. You may calculate the actual portion of a bill that you are responsible for. For example if you shared an appetizer with three friends, had an entree and two drinks simply enter the full price of the appetizer and your percentage of 25, the price of your entree and then the price of your drink and a quantity of 2.
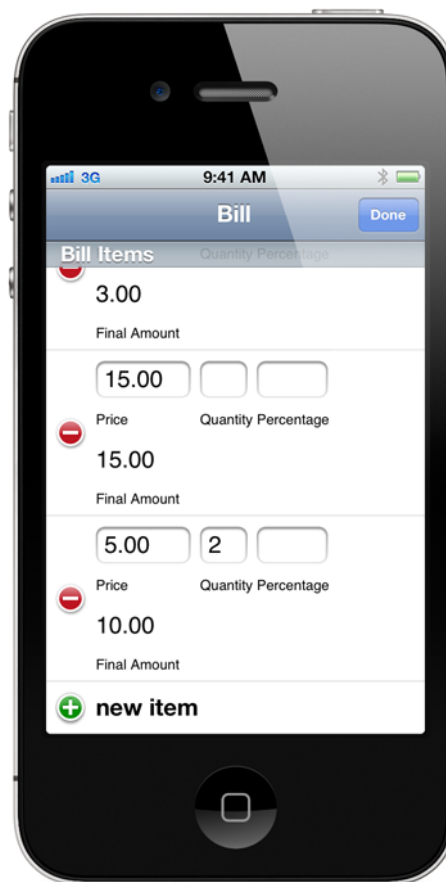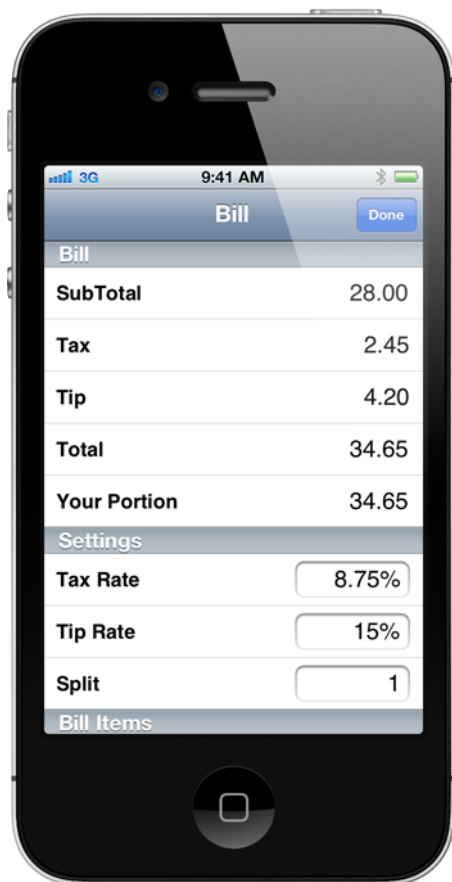
The bill worksheet provides a convenient way to enter, edit and view the various bill amounts. At the top of the worksheet the calculated amounts are automatically displayed. Below are editable fields for the tax rate, tip rate, split and item amounts.

On its flip side Perpenso Calc offers a calculator tape, worksheets, a built-in manual and settings controls.

When Perpenso Calc is launched the calculator is shown. Press the info button on the calculator navigation bar to flip to the tape, worksheets, manual and settings.
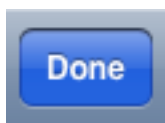
To flip back to the calculator press the done button on the navigation bar.

To switch between the tape, worksheets, manual and settings press the appropriate button on the tab bar.

In App Purchase

The iPhone operating system provides a feature called "In App Purchase" so that apps may use Apple's App Store to provide additional content or functionality. This is all done from within an app and effectively allows developers to add a built-in mini-store. A mini-store offering content or functionality specifically for the app.

The Perpenso Calc 4 app offers the functionality of five specialized calculators: scientific, statistics, business, hex and bill. It is expandable via In-App Purchases. You pay only for the specialized calculator functionality that you need. Scientific functionality is included. Statistics, business, hex and bill functionality is optional.

Note that the Perpenso Calc app includes all five specialized calculators. With its discounted price Perpenso Calc may cost less than adding all your desired functionality to Perpenso Calc 4.

Above Perpenso Calc's numeric display is a segmented control that allows you to select the specialized calculator mode that you wish to use. For modes that are built-in or have been previously purchased you immediately see the appropriate buttons, enabled and ready to use. However if you select an optional mode that has not been previously purchased then an In App Purchase dialog will appear describing the mode and showing its price. If you press the "Done" button the dialog will be dismissed and you will see a preview of the mode. In this preview the buttons are displayed but they are disabled, except for the button that lets you preview secondary functionality. The In App Purchase dialog will only be shown once per app launch. If you wish to see it again quit and relaunch Perpenso Calc.

If you select the "Buy Now" button when the In App Purchase dialog is shown then Perpenso Calc turns control over to the iPhone operating system. Dialogs will appear asking you to confirm the purchase and possibly to enter your iTunes username and password. We want to stress that these dialogs do **not** belong to Perpenso Calc and that we never see your username and password. These dialogs are displayed by and processed by the iPhone operating system.

If you need to restore an optional mode simply go through the purchase process again. Apple's App Store will recognize that you had previously purchased the mode and will not charge you a second time. You may use the "Buy Now" button to restore a specific mode or the "Restore Previous Purchases" button to restore all modes.
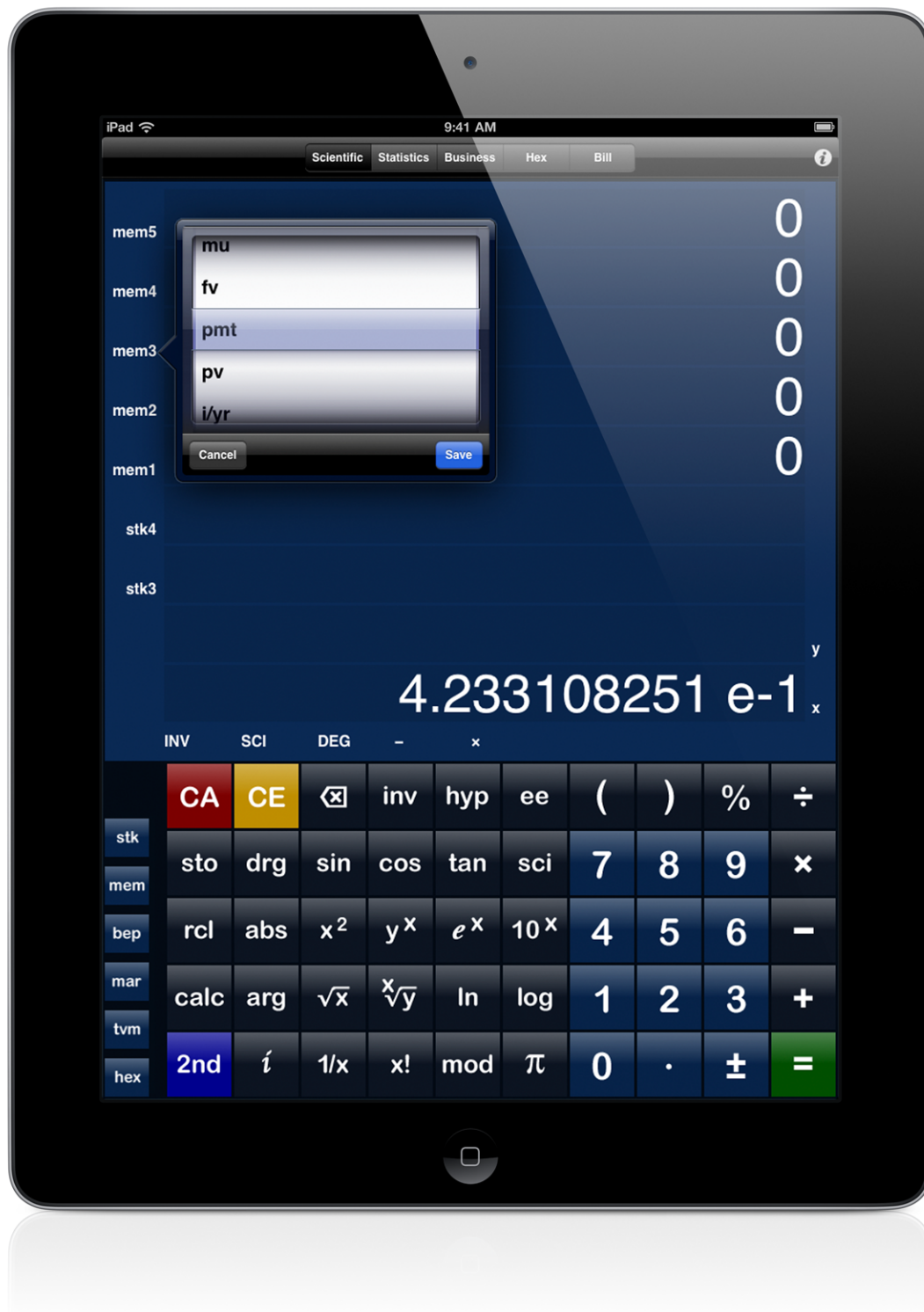
Display

Numeric

On an iPhone when the order of operations is set to chain mode there is a single line numeric display. In RPN mode there is a two line numeric display with y (second on stack) above and x (top of stack) below. X and y labels appear to the right of the numbers as reminders. These labels match the use of x and y on buttons.

On an iPad the y value is always shown, like RPN mode on an iPhone device. Additionally there are seven user definable display lines above the x and y lines. These lines may show additional values on the stack, memory registers or special purpose registers for business and hex modes. Labels appear to the left of the numbers to identify the value currently displayed. Tapping on the label will allow you to change the value.

To the left of the regular calculator buttons are a set of buttons that will redefine all the user definable display lines according to a particular theme. Stack, memory, break even point, profit margin, time value of money and hex, octal, binary and unicode conversions.

Scientific | Statistics | Business | Hex | Bill

mem5

mem4

mem3

mem2

mem1

stk4

stk3

mu
fv
pmt
pv
i/yr

Cancel | Save

0
0
0
0
0

y

$4.233108251 \, e\text{-}1 \, _x$

INV | SCI | DEG | − | ×

	CA	CE	⌫	inv	hyp	ee	(	)	%	÷

stk

| sto | drg | sin | cos | tan | sci | 7 | 8 | 9 | × |

mem

| rcl | abs | x^2 | y^x | e^x | 10^x | 4 | 5 | 6 | − |

bep

| calc | arg | $\sqrt{x}$ | $\sqrt[x]{y}$ | ln | log | 1 | 2 | 3 | + |

mar

tvm

| 2nd | i | 1/x | x! | mod | π | 0 | · | ± | = |

hex

Annunciators

On an iPhone to the left of the numeric display is a block of six annunciators, two columns with three rows. On an iPad the annunciators are located below the numeric display in a single row. These annunciators change with the calculator mode.

Scientific:

Prefix	Previous Operation
Notation	Pending Operation
Angular Mode	Open Parenthesis

Statistics:

Prefix	Previous Operation
X Data Entered	Pending Operation
Y Data Entered	Open Parenthesis

Business / Finance:

Prefix	Previous Operation
Price Mode	Pending Operation
Begin/End Mode	Open Parenthesis

Programmer / Hex:

Prefix	Previous Operation
Type and Size	Pending Operation
Base	*unused*

Bill / Tip:

Previous Operation
Pending Operation
Tip Rounding

Prefix indicates that the behavior of the next button is modified.
    STO - Store.

RCL - Recall.
CAL - Special calculation.
INV - Inverse, also known as arc with respect to trig functions.
HYP - Hyperbolic.
ARH - Inverse Hyperbolic, also known as area hyperbolic.
FIX - Fixed Decimal.

Notation for numeric display.
SCI - Scientific.
ENG - Engineering.

Angular mode identifies the units for trig functions, rotation and complex numbers in polar notation.
DEG - Degrees.
RAD - Radians.
GRAD - Gradians.

Price Mode
BEP - Price will be determined using a breakeven type calculation.
MAR - Price will be determined using a profit margin type calculation.

Beg/End Mode
BEG - Payment at beginning of period.
END - Payment at end of period.

Type and Size.
U64 - Unsigned 64-bit.
S64 - Signed 64-bit.
U32 - Unsigned 32-bit.
S32 - Signed 32-bit.

Base.
DEC - Decimal.
HEX - Hexadecimal.
OCT - Octal.
BIN - Binary.

Tip rounding.
UP - Automatically increase the tip amount so that the total will be rounded up to a whole number.

Previous operation indicates the last operation actually performed. When in chain mode any pending operation is also displayed. Consider entering 1 + 2 =. Prior to pressing the equals button the addition is a pending operation. After pressing the equals button the addition is a previous operation.

In general previous and pending operations are similar to the button labels. Some substitutions are made for readability, for example:

/ replaces ÷, ÷ is too easily mistaken for +.

±% indicates percentage rise/fall rather than a normal %.

^ indicates an exponent, for example x^2 is x^2 and y^x is y^x.

–> indicates a conversion, for example cm–>in is centimeters to inches.

Order of Operations

Chain

Traditional calculators use various order of operations. Common mathematical notation is also known as infix notation. In infix notation the operator appears between two operands, for example 1 + 2. Additional operator and operands may be appended to form a chain of operations, for example 1 + 2 × 4. Operators are evaluated from left to right:

$$1 + 2 \times 4$$
$$\rightarrow \quad (1 + 2) \times 4$$
$$\rightarrow \quad 3 \times 4$$
$$\rightarrow \quad 12$$

This left to right evaluation is also known as chain ordering. Chain ordering offers simplicity and safety since there is no ambiguity in order.

Algebraic

Some calculators offer an alternative where certain operators have precedence over others. This is known as algebraic ordering. If multiplication has precedence over addition then the prior example is ordered differently:

$$1 + 2 \times 4$$
$$\rightarrow \quad 1 + (2 \times 4)$$
$$\rightarrow \quad 1 + 8$$
$$\rightarrow \quad 9$$

Unfortunately different calculators use different precedence rules, even some calculators from the same company.

RPN

Another alternative is to use postfix notation, also known as Reverse Polish Notation (RPN). In RPN the operator appears after the two operands, for example 1 2 +. Additional operands and operators may be appended to form a chain, for example 1 2 + 4 ×, which evaluates from left to right:

$$1\ 2 + 4 \times$$
$$\rightarrow \quad (1\ 2 +)\ 4 \times$$
$$\rightarrow \quad 3\ 4 \times$$
$$\rightarrow \quad 12$$

In calculators RPN operands are pushed onto a stack (defined below) and more than two may be pushed. When an operator is entered the two most recent operands on the stack are used, consumed, and the result is pushed onto the stack. If 4 is pushed onto the stack, followed by 1 and then 2, and an addition is followed by a multiplication:

$$4\ 1\ 2 + \times$$
$$\rightarrow \quad 4\ (1\ 2\ +) \times$$
$$\rightarrow \quad 4\ 3 \times$$
$$\rightarrow \quad 12$$

A stack is a list of values where a value may only be added (pushed) or removed (popped) at one end of the list. This end is known as the top of the stack (TOS).

Perpenso Calc allows many values to be pushed onto the stack. The TOS is often labeled x and the next value y. These match the labels on the calculator buttons. When in RPN mode the calculator display shows these two values with x and y labels as reminders.

When unary operations are performed x is used and popped from the stack. The result is pushed onto the stack and becomes the new x value. If 1 and then 2 are pushed and an x^2 operation is performed then the stack before and after the operation is:

		Before	After
	y	1	1
TOS	x	2	4

When binary operations are performed x and y are used and both are popped from the stack. The result is pushed onto the stack and becomes the new x value. If 1, 2 and then 3 are pushed and a multiplication operation is performed then the stack before and after the operation is:

		Before	After
		1	
	y	2	1
TOS	x	3	6

The data for more than one operation may be entered before performing the first operation. If 4, 2 and 1 are pushed and then addition and multiplication operations are performed the stack before and after the each operation is:

		Before	After +	After ×
		4		
	y	2	4	
TOS	x	1	3	12

Basic Operations

Clearing and Deleting

CA Clear all.
Clears the working registers (display. stack, save/recall, etc.), the data tables (statistics data, cash flows and bill items) or both registers and data. Note that only data tables associated with the current calculator mode are cleared.

For example if you are in bill mode then **CA** will only clear the bill items, statistics data and cash flows are unchanged.

CA may be configured in settings to reset or leave alone the memory registers, payment and compounding periods per year, and hex mode base (radix).

CE Clear entry.
Normally deletes the current number being displayed. However when the order of operations mode is chain then clear entry may also delete pending operations. For example if 1 + 2 is entered then clear entry will delete the number 2 and a new number may be entered. Or clear entry may be pressed a second time to delete the pending addition operation and a new operation may be entered. Or clear entry may be pressed a third time to delete the number 1.

⌫ Delete.
Deletes the last digit of the displayed number. Doing so will enable editing if necessary and you may enter additional digits.

Entering Numbers

0 ··· 9 Decimal digits.
You may enter numbers with up to twenty digits and a four digit exponent. The number is stored internally at full precision but the actual number of digits displayed is subject to the precision setting.

· Decimal point.
In addition to its use in normal decimal numbers the decimal point is used for the entry of fractions and dotted quads. For fractions place a decimal point between the integer part of the number and the fractional numerator and

between the fractional numerator and denominator. For example enter 1.2.3 for one and two-thirds and .3.4 for three-fourths. For dotted quads place a decimal point between each byte value. For example 192.168.0.1. While fractions will continue to be displayed as fractions, dotted quads will be displayed as their decimal equivalent.

± Negate.
Changes the sign of a number. You need to enter a nonzero digit first since negating zero has no effect. When in entry mode and an exponent is present the exponent will be negated.
If immediately preceded by the [calc] prefix it performs a sign operation returning 1, -1 or 0 for positive, negative or zero values.

Storing and Recalling Numbers

sto **rcl** Store, recall.

Store a number into one of ten registers, or recall a number. **sto** and **rcl** act as prefixes and are immediately followed by a decimal digit (0-9) to identify the register. For example **sto** **1**.

rcl may also be used to read various variables used in statistics and business modes.

last Last result, Last x.

In chain mode **last** recalls the result of the most recent calculation. In RPN mode **last** recalls the x value immediately before the most recent calculation.

Special Values

There are several special values that may be displayed where numbers are normally displayed. They generally indicate that a calculation has failed.
undef Undefined, a variable does not contain a valid value.
nan   Not a number, an unrepresentable value.
inf   Infinity.
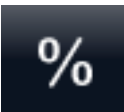
Special Calculations

Calculate.
The calc prefix changes the operation performed by certain buttons.

calc ± performs a sign operation returning 1, -1 or 0 for positive, negative or zero values.
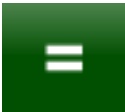
Basic Arithmetic

Addition, subtraction, multiplication and division.

Percent.
Divides the current number by 100. If immediately preceded by the inverse prefix it multiplies the current number by 100.
When in chain mode and if there is an immediately pending addition or subtraction operation then the normally computed percentage is multiplied by the initial term of the addition or subtraction. This calculates the percentage rise or percentage fall of the initial term. For example 120 + 10% has a calculated percentage rise of 12 and an overall result of 132 (120 + 12).

Secondary and primary operations.
Redefines buttons to perform different operations.

Chain Mode Only

Parenthesis.
Parenthesis allow you to postpone a pending operation. Operations inside parenthesis are performed before operations outside. For example if 2 × (3 + 1) is entered the result will be 8, the multiplication is postponed. Without parenthesis the result would be 7.
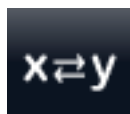
Equals.
Closes all parenthesis and performs all pending operations.

RPN Mode Only
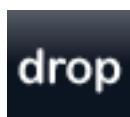
drop Drop.
The number on the top of the stack is popped and discarded and other numbers on the stack move towards the top.

x⇄y Swap XY.
Swaps the top two numbers on the stack while leaving other numbers on the stack unchanged. The top of the stack is considered the x value and the second number on the stack is considered the y value.

roll up **roll down** Roll up and roll down.
Rolls the numbers on the stack upwards and downwards. Note that only the top two numbers on the stack are displayed.

		Before	After roll up	After roll down
Bottom		0	1	3
		1	2	0
	y	2	3	1
Top	x	3	0	2

enter Enter.
Pushes a number onto the stack, often the first number of a two value operation. For example in RPN mode 1 + 2 is calculated by **1** **enter** **2** **+**.

Copy and Paste

Copy and paste are convenient ways to transfer data to and from other applications such as Notes and Mail. Double tap on the main numeric display above the calculator buttons to copy or paste a numeric value. The value may be a decimal number, a fraction or a complex number in cartesian or polar form.

Fractions always contain a numerator and a denominator separated by a forward slash, /. There may be an optional whole number before the numerator and the whole number and numerator must be separated by a space. For example one and two-thirds may be represented as "1 2/3" and three-fourths may be represented as 3/4.

Cartesian complex numbers contain two decimal numbers, the real and imaginary components, separated by the sign of the imaginary component. The imaginary component includes a trailing i. Given a real component of 1.2 and an imaginary component of 3.4 the representation would be 1.2+3.4i. Polar complex numbers have

their magnitude and angular components separated by the symbol theta, θ. As a convenience the letter t may be substituted for theta. Given a magnitude of 5.6 and an angle of 45 degrees the representations would be 5.6θ45 or 5.6t45. By default the angular units are degrees. Degrees, radians and gradians may be indicated by following the angular component with the letters d, r and g. A space must separate the angular component and the unit letter. 5.6t45 may alternatively be represented by "5.6t45 d", "5.6t0.785398 r" or "5.6t50 g".

When the calculator is in bill mode a double tap near the bill total allows you to copy the bill.

When the calculator tape is displayed a double tap allows you to copy the tape.

Scientific Operations

Fractions

1 2 / 3 Fractions are generally interchangeable with decimal numbers. Nearly all operators accept fractions and will return a fraction when the operands are fractions.

To enter fractions use two decimal points. One decimal point between the integer part of the number and the fractional numerator and another decimal point between the fractional numerator and denominator. For example enter 1.2.3 for one and two-thirds and .3.4 for three-fourths.

The maximum denominator defined in settings allows you to limit fractions to reasonable values. Fractions with denominators larger than the defined maximum will be displayed as decimal numbers.

Complex Numbers

1.2 + 3.4i **5.6 θ 45** Complex numbers are not supported by all operators. The operators that support complex numbers are:

+ **−** **×** **÷** Addition, subtraction, multiplication and division.

% Percent.

± Negate.

calc **±** Sign.

trun **frac** **abs** **⌊x⌉** **⌊x⌋** **⌈x⌉** Truncate, fractional component, absolute value, round, floor and ceiling.

x^2 **$\sqrt{x}$** **y^x** **$\sqrt[x]{y}$** Square, square root, power and xth root.

e^x **ln** **10^x** **log** Natural exponential, natural logarithm, common exponential and common logarithm.

1/x Reciprocal.

sin **cos** **tan**   Sine, cosine and tangent.

inv **sin**   ... Arcsine, arccosine and arctangent.

hyp **sin**   ... Hyperbolic sine, cosine and tangent.

inv **hyp** **sin**   ... Hyperbolic arcsine, arccosine and arctangent.

real **imag**   Real part and imaginary part.

**abs** **arg**   Magnitude and argument (angle).

conj   Conjugate.

rot   Rotate.

Use the **i** and **θ** buttons to create complex numbers. To enter a complex

number in cartesian form enter the real part, press **i**, and then enter the imaginary
part. The complex number is displayed as x + yi where x represents the real part and y
the imaginary part, for example 1.2 + 3.4i. To enter a complex number in polar form

enter the magnitude, press **θ**, and then enter the angle. The complex number is
displayed as x θ y where x is the magnitude and y is the angle, for example 5.6 θ 45.

Rectangular and Polar Coordinate Conversion

There is no explicit coordinate conversion because complex numbers provide the same
functionality. Enter your coordinate as a cartesian (rectangular) or polar complex

number and use the **i** and **θ** buttons to convert. For example create a
complex number in cartesian form, use x for the real part and y for the imaginary part,

and press **θ** to convert to polar form. Or create a complex number in polar form

and press **i** to convert to cartesian form.

Entering Numbers
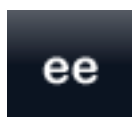
ee   Exponent entry.
Begins the entry of an exponent of 10. An e is shown on the display, 1.2 e3 represents 1.2×10^3. Numbers that fit on the display may be shown without an exponent even if they were entered with an exponent, for example 1.2 e3 may be displayed as 1200. To force the use of exponents enable scientific or engineering notation, see **sci** and **eng**.

i   Complex number entry, cartesian form.
Normally begins the entry of the imaginary part of a complex number. To enter a complex number enter the real part, press **i**, and then enter the imaginary part. The complex number is displayed as x + yi where x represents the real part and y the imaginary part, for example 1.2 + 3.4i.

If a complex number in polar form is currently displayed then **i** will convert this number to cartesian form.

If in RPN mode and if the **calc** prefix immediately precedes **i** then the top two numbers on the stack are popped and used to create a complex number in cartesian form. X is used for the real part and y the imaginary part.

θ   Complex number entry, polar form.
Normally begins the entry of the angular part of a complex number. To enter a complex number enter the magnitude, press **θ**, and then enter the angle. The complex number is displayed as x θ y where x is the magnitude and y is the angle, for example 5.6 θ 45.

If a complex number in cartesian form is currently displayed then **θ** will convert this number to polar form.

If in RPN mode and if the **calc** prefix immediately precedes **θ** then the top two numbers on the stack are popped and used to create a complex number in polar form. X is used for the magnitude and y the angle.

Displaying Numbers

fix Fixed decimal.
The fix prefix is immediately followed by a digit (0-9) indicating the number of digits to display after the decimal point or it is followed by a decimal point to cancel fixed decimal mode. Fixed decimal will always display the designated number of digits and add trailing zeros if necessary. It overrides the precision setting.

sci Scientific notation.
Toggles scientific notation mode. In scientific notation a number has a single digit before the decimal point and an exponent.

eng Engineering notation.
Toggles engineering notation mode. In engineering notation a number has one to three digits before the decimal point and an exponent that is a multiple of three.

Arithmetic

trun Truncate.
Discards the fractional digits so that only the integer portion of a number remains. For example the truncation of 123.456 produces 123.

frac Fractional component.
Discards the integer digits so that only the fractional portion of a number remains. For example the fractional component of 123.456 is 0.456.

abs Absolute Value.

⌊x⌉ Round.
Produces the nearest integer number.

⌊x⌋ Floor.
Produces the next smallest integer number.

⌈x⌉ Ceiling.
Produces the next largest integer number.

x^2 Square.

$\sqrt{x}$ Square root.
If square root is performed on a negative number then the result will be a complex number. For example the square root of -9 is 0 + 3i.

y^x Power.

$\sqrt[x]{y}$ x^{th} root.
If y is negative then x must be an odd integer.

e^x Natural exponential

Note that the constant e is easily produced by entering 1 e^x .

ln Natural logarithm (base e).

10^x Common exponential.

log Common logarithm (base 10).

1/x   Reciprocal.

x!   Factorial.

mod   Modulo.

rand   Random.
Produces a pseudo-random number between zero and one.

Trigonometry

inv   **hyp**   Inverse and hyperbolic.
The inverse and hyperbolic prefixes may be used individually or together with the sine, cosine and tangent operations. **inv** indicates that the inverse trig function is to be performed and **hyp** indicates that the hyperbolic trig function is to be performed. For example:

Buttons	Operation
sin	sine
inv **sin**	arcsine
hyp **sin**	hyperbolic sine
inv **hyp** **sin**	hyperbolic arcsine

π Pi.

drg Degrees, radians, gradians.
Cycles the angular mode between degrees, radians and gradians. If immediately preceded by the calc prefix then the currently displayed number is also converted to the new unit of measurement.

sin Sine.

cos Cosine.

tan Tangent.

Complex Numbers

real Real part.

imag Imaginary part.

abs Magnitude.
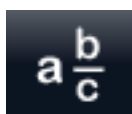
arg Argument.

conj   Conjugate.

rot   Rotate.
Rotates a point in the complex plane around the origin. The initial term of the rotate operation is a complex number indicating the point in the plane and the second term is a decimal number indicating the angular units (degrees, radians, gradians) to rotate.

Fractions

$a \frac{b}{c}$ Fraction.
Attempts to convert a decimal number to a fraction. Some numbers cannot be accurately converted to a fraction and will remain decimal numbers.

If a fraction is currently displayed then $a \frac{b}{c}$ toggles between proper and improper forms.

If the **inv** prefix immediately precedes $a \frac{b}{c}$ then a fraction is converted to a decimal number.

For example 1.625 $a \frac{b}{c}$ yields 13/8. Pressing $a \frac{b}{c}$ a second time yields 1 5/8.

Following this with **inv** $a \frac{b}{c}$ yields 1.625.

The maximum denominator defined in settings allows you to limit fractions to reasonable values. Fractions with denominators larger than the defined maximum will be converted to decimal numbers.

Conversions

All conversions may be reversed by immediately preceding the conversion with the inverse prefix. For example to convert kilograms to pounds use **inv** **lb kg**. In settings the conversion operations may be set to use US customary, US food nutrition or Imperial units. US food nutrition units are primarily used for labeling.

inch cm   Inch to centimeter.

mile km   Mile to kilometer.

lb kg   Pound to kilogram.

oz g   Ounce to gram.

gal l   Gallon to liter.

fl oz ml   Fluid ounce to milliliter.
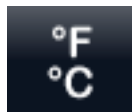
°F °C   Fahrenheit to Celsius.

hms dec   Hours:minutes:seconds to decimal or degrees° minutes' seconds" to decimal.
Converts from hexagesimal (H.MMSSsss or D.MMSSsss) to decimal (H.hhh or D.ddd) notation. In hexagesimal notation the hours or degrees are represented by the integer portion of a number (H or D) and the minutes and seconds are represented by the fractional portion. The first two fractional digits represent the minutes (MM, 00-59), the next two digits represent the integer seconds (SS, 00-59) and any additional digits represent the fractional seconds (sss). In decimal notation the fractional digits represent the fractional hours (hhh) or the fractional degrees (ddd).

Examples:

Hours	Minutes	Seconds	Hexagesimal	Decimal
		1	0.0001	0.000277778
		1.25	0.000125	0.000347222
	1	0	0.01	0.016666667
1	2	3	1.0203	1.034166667
11	22	33	11.2233	11.375833333

Special Calculations

calc Calculate.
The calc prefix changes the operation performed by certain buttons.

calc **drg** Cycles the angular mode between degrees, radians and gradians and converts the currently displayed number to the new unit of measurement.

calc **i** RPN mode only. Pops the top two numbers on the stack and creates a complex number in cartesian form. X is used for the real component and y the imaginary component.

calc **θ** RPN mode only. Pops the top two numbers on the stack and creates a complex number in polar form. X is used for the magnitude and y the angle.

Statistical Operations

(Included in Perpenso Calc, optional in Perpenso Calc 4)

Entering Data

nvar Number of variables.
Toggles between single and two variable data modes.

If immediately preceded by the **calc** prefix then single variable data will be converted to two variable data. There must be an even number of data items.

data Enter statistical data.

In single variable mode each use of **data** enters a new x entry.

In two variable mode the first use of **data** enters an x entry and a second use enters a y entry. Further use enters x,y pairs as just described.

If immediately preceded by the **calc** prefix then the most recent x or x,y pair will be deleted.

Data may also be entered and edited in the statistics worksheet.

file Read data from a file.
You may provide a URL to a file to read data from. The file must be a text file containing numeric data only, no labels or comments. Each entry (x or x,y pair) is on a new line and x y data is separated by commas or tabs. Or the data may be a simple list of values separated by spaces. If a simple list is used there is no way to automatically detect two variable data. However this can be worked around by converting single variable data to two variable data using **calc** **nvar**.

	Single Variable	Two Variable
Comma Separated Values	X_1 X_2	X_1,Y_1 X_2,Y_2
Tab Separated Values	X_1 X_2	X_1 Y_1 X_2 Y_2
List of Numbers Separated by Spaces	X_1 X_2	X_1 Y_1 X_2 Y_2

Sample files may be found at http://www.perpenso.com/calc/, append one of the following filenames to the preceding URL.

	Single Variable	Two Variable
Comma Separated Values	one.csv	two.csv
Tab Separated Values		two.tsv
List of Numbers Separated by Spaces	one.txt	two.txt
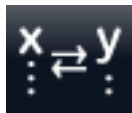
Swap XY Data.
When in two variable data mode swap the x and y entries. The more popular statistical operations can be performed on either the x or y entries. However the less frequently used operations can only be performed on the x entries. If

you wish to perform such an operation on the y entries use [icon] to swap x and y entries, perform the operation, and then swap the x and y entries back.

Number of data entries.
In single variable mode the number of x entries is displayed.
In two variable mode the number of x,y pairs is displayed.

Descriptive Statistics

min

Minimum x.
Determines the minimum of single variable data or the x entries of two variable data.

max

Maximum x.
Determines the maximum of single variable data or the x entries of two variable data.

md

Median x.
Calculates the median of single variable data or the x entries of two variable data.

mo

Mode x.
Calculates the mode of single variable data or the x entries of two variable data. If the data is multimodal an error is indicated and the value shown is the first mode.

$\bar{x}$

Mean x.
Calculates the mean of single variable data or the x entries of two variable data.

$\bar{y}$

Mean y.
Calculates the mean of the y entries of two variable data.

z

Z-Score.
Determines how far an observation is from mean x.

$\bar{x}_w$

Weighted mean.
Calculates the mean of x weighted by y.

gm

Geometric mean x.
Calculates the geometric mean of single variable data or the x entries of two variable data.

s_x

Sample standard deviation x.
Calculates the sample standard deviation of single variable data or the x entries of two variable data.

s_y
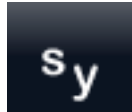
Sample standard deviation y.
Calculates the sample standard deviation of the y entries of two variable data.

σ_x
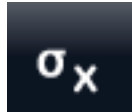
Population standard deviation x.
Calculates the population standard deviation of single variable data or the x entries of two variable data.

σ_y

Population standard deviation y.
Calculates the population standard deviation of the y entries of two variable data.

s_xy

Sample covariance.
Calculates the sample covariance of two variable data.

If immediately preceded by the `calc` prefix then a population covariance is calculated. Many spreadsheets use the population calculation rather than the sample.

r_xy
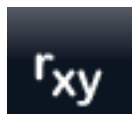
Sample Pearson correlation coefficient.
Calculates the sample Pearson correlation coefficient of two variable data. This is of particular interest in linear regression where it indicates how closely the calculated line fits the two variable data. It is the r in the often used r^2.

If immediately preceded by the `calc` prefix then a population correlation coefficient is calculated. Many spreadsheets use the population calculation rather than the sample.

Σx

Sum x values.

Σy
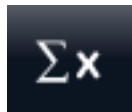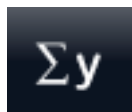
Sum y values.

$\sum xy$ Sum xy products.

$\sum x^2$ Sum x^2 values.

$\sum y^2$ Sum y^2 values.

Linear Regression

m   Slope.
Calculates the slope of the linear regression of two variable data.

b   Y-intercept.
Calculates the y-intercept of the linear regression of two variable data.

x′   Predicted x.
Calculates a predicted x position given a hypothetical y position.

y′   Predicted y.
Calculates a predicted y position given a hypothetical x position.

ssr   Sum of squares due to regression.

sse   Sum of squares due to error.

Also note that the sample correlation coefficient, r_{xy}, indicates how closely the calculated line fits the two variable data. It is the r in the often used r^2.

Percentile

There is no standard definition of percentile. The U.S. National Institute of Standards and Technology offers calculations that are commonly used in software applications such as spreadsheets and in textbooks, http://www.itl.nist.gov/div898/handbook/prc/section2/prc252.htm. By default Perpenso Calc uses the spreadsheet style calculation but textbook style is also available via the **calc** prefix.

P$_k$ Percentile.
Calculates the kth percentile of single variable data or the x entries of two variable data. k should be in the range 0 to 100. By default a spreadsheet style calculation is used but note that many spreadsheets expect an alpha value in the range 0.0 to 1.0 rather than k.

If immediately preceded by the **calc** prefix then a textbook style calculation is used.

Probability

nCr Combinations.
Determines how many combinations of r members can be selected from a population of n members.

Example: **7** **nCr** **3** yields 35.

nPr Permutations.
Determines how many permutations of r members can be selected from a population of n members.

Example: **7** **nPr** **3** yields 210.
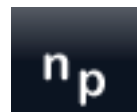
n$_p$ Number of elements in population.
Sets the variable for the number of elements in the population. This variable

is used by the binomial and hypergeometric probability functions, **bin** and **hgeo**.

If the recall prefix, **rcl**, is used then the variable is read.

n_t Number of trials.
Sets the variable for the number of trials. This variable is used by the hypergeometric probability function, **hgeo**.

If the recall prefix, **rcl**, is used then the variable is read.

p_s Probability of success or number of successful elements.
Sets a variable that contains either the probability of success used by the binomial and geometric probability functions, **bin** and **geo**, or the number of successful elements in the population used by the hypergeometric probability function, **hgeo**.

If the recall prefix, **rcl**, is used then the variable is read.

λ Expected value.
Sets the variable for the expected value. This variable is used by the poisson probability function, **pois**.

If the recall prefix, **rcl**, is used then the variable is read.

geo Geometric probability function.
Calculates the probability of the first success occurring on the xth trial. This is the non-shifted function supporting x = 0, 1, 2, ...

Prerequisites: the probability of success variable, **p_s**, must be set.

Example: Given 0.3 as the probability of success what is the probability of the first success on trial number 5?

0 **·** **3** p_s

5 geo

The probability is 0.07.

pois Poisson probability function.
Calculates the probability of x occurrences in an interval.

Prerequisites: the expected value variable, λ, must be set.

Example: Given 10 expected successes what is the probability of exactly 5 successes?

1 **0** λ

5 pois

The probability is 0.04.

bin Binomial probability function.
Calculates the probability of x successes in n trials.
Prerequisites: the number of trials and probability of success variables,

n_t and p_s, must be set.

Example: Given 3 trials and a probability of success on any one trial of 0.3, what is the probability of 2 successes?

3 n_t

0 **·** **3** p_s

2 bin

The probability is 0.19.

hgeo Hypergeometric probability function.
Calculates the probability of x successes in n trials. The hypergeometric probability function is similar to the binomial probability function except that the trials are not independent and the probability of success changes from trial to trial. Basically selections are removed.

Prerequisites: the number of elements in population, n_p, number of trials, n_t, and number of successful elements in population, p_s, variables must be set.

Example: Given a population of 12 where 5 match the desired criteria, what is the probability of exactly 1 match if 3 are tested?

1	2	n_p
5	p_s	
3	n_t	
1	hgeo	

The probability is 0.48.

Special Calculations

calc Calculate.
The calc prefix changes the operation performed by certain buttons.

calc **nvar** Single variable data will be converted to two variable data.

calc **P_k** Calculates the kth percentile using a textbook style method.

calc **s_{xy}** Calculates the population covariance of two variable data.

calc **r_{xy}** Calculates the population correlation coefficient of two variable data.

Worksheet

While the button based interface of a traditional handheld calculator works well for many things it is awkward for some tasks. Editing data is one such task. Fortunately iOS provides a modern and powerful graphical interface.

Worksheets offer a more natural way to enter, edit and view data and to perform some common calculations. In the statistics worksheet data may be entered and edited in a table. Above this table descriptive statistics such as mean and standard deviation are automatically displayed. In two variable mode a linear regression is also automatically displayed.

The calculations shown in the statistics worksheet includes:

Number of observations
Mean
Sample Standard Deviation
Population Standard Deviation
Minimum
Maximum
Median
Slope
Y-Intercept
Covariance
Correlation
R^2
SSR
SSE

 To navigate to the statistics worksheet press the info button on the calculator navigation bar to flip to the tape, worksheets, manual and settings.

Press the worksheets tab.

 To flip back to the calculator press the done button on the navigation bar.

Business / Financial Operations

(Included in Perpenso Calc, optional in Perpenso Calc 4)

Entering Cash Flows

cf   Enter cash flow.

Each use of **cf** enters a new cash flow group. A group includes a cash flow and the number of times it repeats. By default the repeat value is set to one.

Note that cash flows are numbered beginning with zero. When you enter the first cash flow, often referred to as the initial cash flow, the annunciator will indicate 0 not 1.

If immediately preceded by the **calc** prefix then the most recent cash flow group will be deleted.

rpt   Repeat cash flow.
Sets the repeat value of the most recently entered cash flow group.

Cash flows may also be entered and edited in the cash flow worksheet.

Example: Enter the cash flows -1000, 200, 300, 300, 300, 400.

1	0	0	0	±	cf
2	0	0	cf
3	0	0	cf
3	rpt
4	0	0	cf

Memory

The M register is a convenient place to maintain a running total. It is unrelated to registers 0 through 9.

mc

M register clear.
Stores zero into the M register.

m-

M register subtraction.
Subtract a number from the M register.

m+

M register addition.
Add a number to the M register.

mr
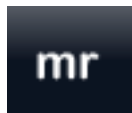
M register recall.
Recall a number from the M register.

Periods

p/yr

Payment periods per year.
Sets the payment periods per year and compounding periods per year

variables, **p/yr** and **c/yr**.

c/yr

Compounding periods per year.
Sets the compounding periods per year variable. Note that the payment

periods per year button, **p/yr**, also sets the compounding periods per year.
Its very common for the payment and compounding periods per year to be the same.

However when they differ set compounding, **c/yr**, after payments, **p/yr**.

Interest Rate Conversion

nom %

Nominal interest rate.
Sets the nominal interest rate variable. Note that the rate is entered as a percentage not a fractional decimal value. A 5% rate would be entered as 5 not 0.05.

If immediately preceded by the [calc] prefix then the nominal interest rate is calculated using the effective interest rate and compounding periods per year variables, [eff %] and [c/yr].

Example: What is the nominal interest rate given an effective rate of 10% compounded monthly?

[1] [2] [p/yr]

[1] [0] [eff %]

[calc] [nom %]

The nominal rate is 9.57.
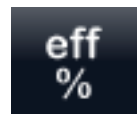
[eff %] Effective interest rate.
Sets the effective interest rate variable. Note that the rate is entered as a percentage not a fractional decimal value. A 5% rate would be entered as 5 not 0.05.

If immediately preceded by the [calc] prefix then the effective interest rate is calculated using the nominal interest rate and compounding periods per year variables, [nom %] and [c/yr].

Example: What is the effective interest rate given a nominal rate of 12% compounded semiannually?

[2] [p/yr]

[1] [2] [nom %]

[calc] [eff %]

The effective rate 12.36.

effc % Effective interest rate with continuous compounding.

Sets the effective interest rate variable. **eff %** and **effc %** represent the same variable, only the calculated values differ. Note that the rate is entered as a percentage not a fractional decimal value. A 5% rate would be entered as 5 not 0.05.

If immediately preceded by the **calc** prefix then the effective interest rate using continuous compounding is calculated using the nominal interest rate, **nom %**.

Example: What is the effective interest rate using continuous compounding given a nominal interest rate of 11?

1 **1** **nom %**
calc **effc %**

The effective rate 11.63.

Percentages
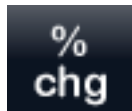
% chg Percent change.
Calculates the percent of change from the initial term to the second term.

Example: If a price rises from 12.50 to 15.00, what is the percent of change?

1 **2** **·** **5** **% chg** **1** **5** **=**

The percentage change is 20.

Breakeven Point

fc Fixed cost.
Sets the total fixed cost variable.

If immediately preceded by the **calc** prefix then the fixed cost is calculated

using the price, variable cost, quantity and profit variables; prc , vc , qty and

prof . Note that profit is total profit not per unit profit.

Example: What is the total fixed cost given a total profit of 250, a per unit variable cost of 2, a per unit price of 5 and a quantity of 200?

2 5 0 prof

2 vc

5 prc

2 0 0 qty

calc fc

The fixed cost is 350.

VC
Variable cost.
Sets the per unit variable cost variable.

If immediately preceded by the calc prefix then the variable cost is calculated using the price, fixed cost, quantity and profit variables; prc , fc , qty

and prof . Note that profit is total profit not per unit profit.

Example: What is the per unit variable cost given a total profit of 250, a total fixed cost of 350, a per unit price of 5 and a quantity of 200?

2 5 0 prof

3 5 0 fc

5 prc

2 0 0 qty

The variable cost is 2.

Quantity.
Sets the quantity variable.

If immediately preceded by the prefix then the quantity is calculated using the price, fixed cost, variable cost and profit variables; , , and . Note that profit is total profit not per unit profit.

Examples:

What is the quantity given a total profit of 250, a total fixed cost of 350, a per unit variable cost of 2 and a per unit price of 5?

The quantity is 200.

What was the breakeven point?
The breakeven point is where the profit is zero.

The breakeven point was reached at a quantity of 117 (116.67).

prof Profit.
Sets the total profit variable.

If immediately preceded by the **calc** prefix then the profit is calculated
using the price, fixed cost, variable cost and quantity variables; **prc**, **fc**, **vc**
and **qty**. Note that profit is total profit not per unit profit.

Example: What is the total profit given a total fixed cost of 350, a per unit variable cost
of 2, a per unit price of 5 and a quantity of 200?

| 3 | 5 | 0 | fc |

| 2 | vc |

| 5 | prc |

| 2 | 0 | 0 | qty |

| calc | prof |

The profit is 250.

prc Price.
Sets the per unit price variable.

If immediately preceded by the **calc** prefix then the price is calculated
using the profit, fixed cost, variable cost and quantity variables; **prof**, **fc**, **vc**
and **qty**. Note that profit is total profit not per unit profit.

Example: What is the per unit price given a total profit of 250, a total fixed cost of 350, a
per unit variable cost of 2 and a quantity of 200?

| 2 | 5 | 0 | prof |

| 3 | 5 | 0 | fc |

| 2 | vc |

| 2 | 0 | 0 | qty |

| calc | prc |

The price is 5.

Also note that price can be calculated as either a breakeven point type calculation or a profit margin type calculation The type of calculation used depends on whether the most recent variable set is from the breakeven point family or the profit margin family. An annunciator on the display indicates the current calculation mode, "BEP" for breakeven point and "MAR" for profit margin.

Profit Margin

mu   Markup.
Sets the markup variable. Note that the markup is entered and displaye as a percentage not a fractional decimal value. A 25% markup would be entered as 25 not 0.25.

If immediately preceded by the calc prefix then the markup is calculated using the cost and price variables, cst and prc .

Example: What is the markup given a cost of 10 and a price of 15?

| 1 | 0 | cst |

| 1 | 5 | prc |

| calc | mu |

The markup is 50 percent.

cst

Cost.
Sets the cost variable.

If immediately preceded by the **calc** prefix then the cost is calculated using the price variable, **prc** , and either the markup or margin variable, **mu** or **mar** , whichever is not zero.

Examples:

What is the cost given a price of 15 and a markup of 50?

1 **5** **prc**
5 **0** **mu**
0 **mar**
calc **cst**

The cost is 10. Note that the margin variable was set to zero to ensure that markup was used in this calculation.

What is the cost given a price of 15 and a margin of 33.33?

1 **5** **prc**
0 **mu**
3 **3** **·** **3** **3** **mar**
calc **cst**

The cost is 10. Note that the markup variable was set to zero to ensure that margin was used in this calculation.

prc

Price.
Sets the price variable.

If immediately preceded by the **calc** prefix then the price is calculated using

the cost variable, cst , and either the markup or margin variable, mu or mar ,
whichever is not zero.

Examples:

What is the price given a cost of 10 and a markup of 50?

1 0 cst
5 0 mu
0 mar
calc prc

The price is 15. Note that the margin variable was set to zero to ensure that
markup was used in this calculation.

What is the price given a cost of 10 and a margin of 33.33?

1 0 cst
0 mu
3 3 · 3 3 mar
calc prc

The price is 15. Note that the markup variable was set to zero to ensure that
margin was used in this calculation.

Also note that price can be calculated as either a breakeven point type calculation or a
profit margin type calculation The type of calculation used depends on whether the most
recent variable set is from the breakeven point family or the profit margin family. An
annunciator on the display indicates the current calculation mode, "BEP" for breakeven
point and "MAR" for profit margin.

mar Margin.
Sets the margin variable. Note that the margin is entered as a percentage not a fractional decimal value. A 25% margin would be entered as 25 not 0.25.

If immediately preceded by the **calc** prefix then the margin is calculated using the cost and price variables, **cst** and **prc**.

Example: What is the margin given a cost of 10 and a price of 15?

1 **0** **cst**
1 **5** **prc**
calc **mar**

The margin is 33 percent (33.33).

Dependencies for Breakeven and Profit Margin Calculations

	Operands							
	fc	**vc**	**qty**	**prof**	**mu**	**cst**	**mar**	**prc**
fc		✓	✓	✓				✓
vc	✓		✓	✓				✓
qty	✓	✓		✓				✓
prof	✓	✓	✓					✓
mu						✓		✓
cst					✓			✓
							✓	✓
mar						✓		✓
prc	✓	✓	✓	✓				
						✓	✓	
					✓	✓		

Time Value of Money

When entering values for variables such as present value, payment and future value

([pv] , [pmt] and [fv]) outputs are negative and inputs are positive. For example money you deposit when opening a savings account is a negative present value but money you borrow is a positive present value.

[begin end]   Begin/End Mode.
Toggles between begin and end modes. This mode determines whether payments take place at the beginning or end of a period.

[n]   Number of periods.
Sets the number of periods variable.

If immediately preceded by the [calc] prefix then the number of periods is calculated using the interest rate per year, present value, payment, future value,

payment periods per year, compounding periods per year and mode variables; [i/yr] ,

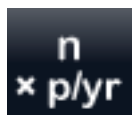[pv] , [pmt] , [fv] , [p/yr] , [c/yr] and [begin end] .

Example: You borrowed 1,000 at 5% and can make monthly payments of 50, how long will it take to pay back this loan?

If the mode annunciator shows "BEG" then switch to the end of period mode by pressing [begin end] .

[1] [2] [p/yr]

[5] [i/yr]

[1] [0] [0] [0] [pv]

[5] [0] [±] [pmt]

[0] [fv]

[calc] [n]

The number of periods is 20.93 years.

n × p/yr   Number of years.

Sets the number of periods variable, **n**, using the operand multiplied by the payment periods per year variable, **p/yr**.

Any prefixes used with this button will act upon the number of periods button, **n**.

Example: Set the number of periods for a 30 year mortgage.

1 **2** **p/yr**
3 **6** **0** **n**

or

1 **2** **p/yr**
3 **0** **n × p/yr**
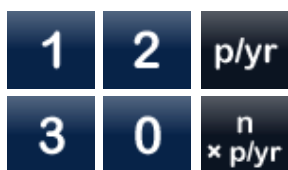
i/yr   Interest rate per year.
Sets the interest rate per year variable.

If immediately preceded by the **calc** prefix then the interest rate per year is calculated using the number of periods, present value, payment, future value, payment periods per year, compounding periods per year and mode variables; **n**, **pv**, **pmt**, **fv**, **p/yr**, **c/yr** and **begin end**.

Example: What annual return do you need in order to double your money in 7 years?

If the mode annunciator shows "BEG" then switch to the end of period mode by pressing **begin end**.

1 **p/yr**

7	n

1	±	pv

0	pmt

2	fv

calc	i/yr

The interest rate is 10.41 percent.

pv Present value.
Sets the present value variable.

If immediately preceded by the **calc** prefix then the present value is calculated using the number of periods, interest rate per year, payment, future value, payment periods per year, compounding periods per year and mode variables; **n** ,

i/yr , **pmt** , **fv** , **p/yr** , **c/yr** and **begin end** .

Example: You have secured a 5 year loan at 6% and you can afford a monthly payment of 400, what is the maximum that you can borrow (aka the present value)?

If the mode annunciator shows "BEG" then switch to the end of period mode by pressing **begin end** .

1	2	p/yr

6	0	n

6	i/yr

4	0	0	±	pmt

0	fv

calc	pv

The present value is 20,690.22.

pmt Payment.
Sets the payment variable.

If immediately preceded by the **calc** prefix then the payment is calculated using the number of periods, interest rate per year, present value, future value, payment periods per year, compounding periods per year and mode variables; **n** , **i/yr** , **pv** , **fv** , **p/yr** , **c/yr** and **begin end** .

Examples:

You have secured a 5 year loan at 6% and may borrow a maximum of 20,000. What would your maximum monthly payment be?

If the mode annunciator shows "BEG" then switch to the end of period mode by pressing **begin end** .

1 **2** **p/yr**

5 **n × p/yr**

6 **i/yr**

2 **0** **0** **0** **0** **pv**

0 **fv**

calc **pmt**

The payment is -386.66.

If the loan is compounded quarterly rather than monthly what would your maximum monthly payment be?

4 **c/yr**

[calc] [pmt]

The payment is -386.38.

[fv] Future value.
Sets the future value variable.

If immediately preceded by the [calc] prefix then the future value is calculated using the number of periods, interest rate per year, present value, payment, payment periods per year, compounding periods per year and mode variables; [n] , [i/yr] , [pv] , [pmt] , [p/yr] , [c/yr] and [begin end] .
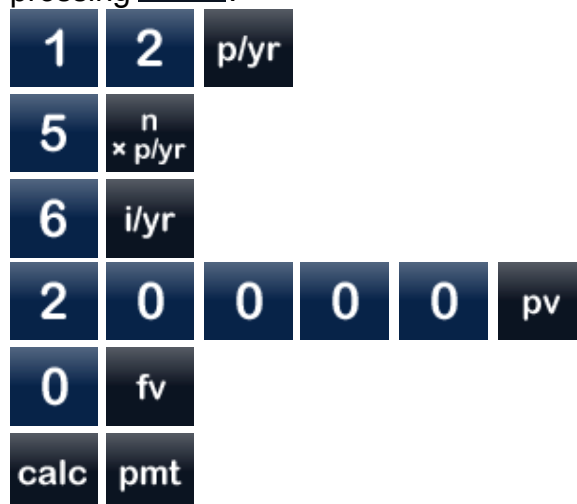
Example: You opened a savings account earning 5% and you will deposit 100 per month, what will the balance be after 5 years?

If the mode annunciator shows "BEG" then switch to the end of period mode by pressing [begin end] .

[1] [2] [p/yr]

[6] [0] [n]

[5] [i/yr]

[1] [0] [0] [±] [pmt]

[0] [pv]

[calc] [fv]

The future value is 6,800.61.

Amortization
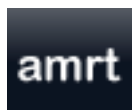
[amrt] Amortization.
Displays the balance, interest portion of the payment and the principal portion of the payment for a single period; or the amount of interest and

71

principle paid in a range of periods. If a single period has been displayed then **amrt** may be pressed a second time in order to display the next period.
Prerequisite: A time value of money calculation must have been performed.

Examples:

Start with a payment calculation from a previous example.
If the mode annunciator shows "BEG" then switch to the end of period mode by pressing **begin end** .

1 **2** **p/yr**

5 **n × p/yr**

6 **i/yr**

2 **0** **0** **0** **0** **pv**

0 **fv**

calc **pmt**

The payment is -386.66.

What is the total amount of principal and interest to be paid?
The range to be used will be 1 through 60, encoded as 1.60.

1 **·** **6** **0** **amrt**

The total amount of principal and interest is approximately -20,000 and -3,199.

What is the amount of principal and interest to be paid during the first year?
The range to be used will be 1 through 12, encoded as 1.12.

1 **·** **1** **2** **amrt**

The amount of principal and interest is approximately -3,536 and -1,104.

What is the amount of principal and interest to be paid in the 23rd month?

2 **3** **amrt**

The amount of principal and interest is approximately -320 and -67.

Note that internal calculations are using the rounded periodic payment value and as a result the amortization values are not exact. This is normal and expected behavior. If you would like greater precision then use the fixed decimal command, **fix**, as desired before calculating the payment.

Cash Flows

r/yr Reinvestment rate per year.
Sets the reinvestment rate per year variable.

npv Net present value.
The net present value is calculated using the cash flows and the payments per year and interest rate per year variables, **p/yr** and **i/yr**.

Example: What is the net present value given the cash flows -2000, 500, 500, 5000?

1 **p/yr**

1 **0** **i/yr**

2 **0** **0** **0** **±** **cf**

5 **0** **0** **cf**

2 **rpt**

5 **0** **0** **0** **cf**

calc **npv**

The net present value is 2,624.34.

nfv Net future value.
The net future value is calculated using the cash flows and the payments per year and interest rate per year variables, **p/yr** and **i/yr**.

Example: After calculating the net present value as shown above, find the net future value.

calc	nfv

The net future value is 3,493.

pb

Payback.
The payback is calculated using the cash flows.

Example: What is the payback period given the cash flows -2000, 500, 500, 5000?

2	0	0	0	±	cf

5	0	0	cf

cf

5	0	0	0	cf

calc	pb

The payback occurs at 2.2 periods.

dpb

Discounted payback.
The discounted payback is calculated using the cash flows and the interest

rate per year variable, | i/yr | .

Example: After calculating the payback as shown above, find the discounted payback.
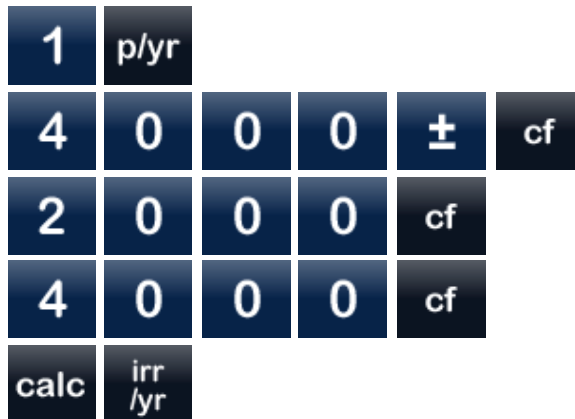
1	0	i/yr

calc	dpb

The discounted payback is 2.3014.

irr /yr Internal rate of return per year.
The internal rate of return is calculated using the cash flows and the payments per year variable, **p/yr** .

Example: What is the internal rate of return given the cash flows -4000, 2000, 4000?

1 **p/yr**

4 **0** **0** **0** **±** **cf**

2 **0** **0** **0** **cf**

4 **0** **0** **0** **cf**

calc **irr /yr**

The internal rate of return is 28.08.

mirr /yr Modified internal rate of return per year.
The modified internal rate of return is calculated using the cash flows and the payments per year, interest rate per year, and reinvestment rate per year variables; **p/yr** , **i/yr** and **r/yr** .

Example: After calculating the internal rate of return as shown above, find the modified internal rate of return.

1 **0** **i/yr**

5 **r/yr**

calc **mirr /yr**
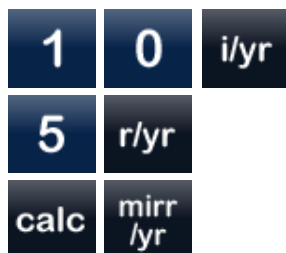
The modified internal rate of return is 23.49.

Dependencies for Time Value of Money and Cash Flow Calculations

	Operands											
	n	i/yr	r/yr	pv	pmt	fv	p/yr	c/yr	cf	beg end	nom %	eff %
n		= 0		✓	✓	✓						
		✓		✓	✓	✓	✓	✓		✓		
i/yr	✓			✓	= 0	✓	✓	✓				
	✓			✓	✓	✓	✓	✓		✓		
pv	✓	= 0			✓	✓						
	✓	✓			✓	✓	✓	✓		✓		
pmt	✓	= 0		✓		✓						
	✓	✓		✓		✓	✓	✓		✓		
fv	✓	= 0		✓	✓							
	✓	✓		✓	✓		✓	✓		✓		
amrt	✓	✓		✓	✓		✓			✓		
npv		✓					✓		✓			
nfv		✓					✓		✓			
irr							✓		✓			
mirr		✓	✓				✓		✓			
pb									✓			
dpb		✓							✓			
nom %								✓				✓
eff %								✓			✓	
effc %											✓	

"= 0" identifies variables holding a value of zero.

Worksheets

In addition to the traditional calculator functionality described above, business worksheets offer a native iOS graphical interface where you may enter and edit data and view some of the more common business calculations. These calculations include:

Breakeven

Fixed Cost
Variable Cost
Quantity
Profit
Price

Profit Margin

Markup
Cost
Margin
Price

Time Value of Money

Periods
Interest per Year
Present Value
Payment
Future Value

Amortization

Total Interest Paid
Total Principal Paid
Interest Paid During a Range of Periods
Principal Paid During a Range of Periods
Balance of an Individual Period
Interest of an Individual Period
Principal of an Individual Period

Cash Flows

Net Present Value
Net Future Value
Internal Rate of Return
Modified Internal Rate of Return

Payback
Discounted Payback

TVM

Timing

Payment Mode	Begin	End
Payments / Year		12
Compoundings / Year		12

Variables

Periods	calc	60
Interest / Year	calc	6%
Present Value	calc	20,000.00
Payment	calc	-386.66
Future Value	calc	0.00

Amortization

Lifetime

Total	-23,199.60
Principal	-20,000.25
Interest	-3,199.35

Range

First Period	1
Last Period	12
Total	-4,639.92
Principal	-3,536.11
Interest	-1,103.81

Amortization

Amortization

Amortization

1 Period	19,713.34 Balance
-286.66 Principal	-100.00 Interest
2 Period	19,425.25 Balance
-288.09 Principal	-98.57 Interest
3 Period	19,135.72 Balance
-289.53 Principal	-97.13 Interest
4 Period	18,844.74 Balance

To navigate to the business worksheets press the info button on the calculator navigation bar to flip to the tape, worksheets, manual and settings.


Press the worksheets tab.
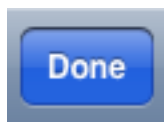
To flip back to the calculator press the done button on the navigation bar.

Programmer / Hex Operations

(Included in Perpenso Calc, optional in Perpenso Calc 4)

All operations using hexadecimal, octal or binary values are subject to the current integer size (64-bit or 32-bit) and the current integer type (unsigned or signed). Bitwise operations using decimal values are also subject to the current integer size and type. However basic mathematical operations (addition, subtraction, multiplication, division, negation and binary exponential and logarithm) using decimal numbers are **not** subject to the current integer size or type. These basic operations will behave just as they do when the calculator is in scientific mode. You may reinterpret the current decimal value using the current integer size and type with a [calc] [=] operation. Note that [calc] [=] only operates on the current value, it does not complete a calculation like the regular [=] operator. In RPN mode [calc] [enter] provides similar functionality.

A single annunciator indicates both the current integer size and type. "U" and "S" indicate the type and "64" and "32" indicate the size.

64-bit and 32-bit Modes

Perpenso Calc normally uses 20 digit decimal values internally. However when entering hexadecimal, octal or binary values, or when bitwise operations are performed, then 64-bit binary values are used internally. 64-bit values represent a smaller range of values than is represented by 20 decimal digits. When 20 decimal digit values are converted to hex, octal or binary then only the 64 low-order bits are used, values wrap around to zero at 2^{64}. For example 2^{64} yields zero, $2^{64}+1$ yields 1, etc. You may also use a 32-bit mode where values are limited to 32-bits. When 20 digit decimal values or 64-bit hex, octal or binary values are converted to 32-bit then only the 32 lower-order bits are used, values wrap around to zero at 2^{32}.

[int size] Integer size.
Toggles between 64-bit and 32-bit modes.

Unsigned and Signed Modes

The bit patterns of hexadecimal, octal and binary values have both signed and unsigned interpretations. For example 32-bit hexadecimal FFFFFFFF may be interpreted as decimal 4294967295 or -1.

int type Integer type.
Toggles between unsigned and signed modes.
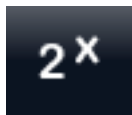
Entering Numbers

A ⋯ **F** Hexadecimal digits.
You may enter numbers with up to sixteen hex digits (64-bit).

Displaying Numbers

base Base (radix).
Sequence through decimal, hexadecimal, octal and binary modes.
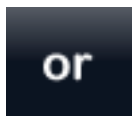
Arithmetic

2^x Binary exponential.

$\log_2$ Binary logarithm.

Bitwise Operations

not Not.

and And.

or Or.

xor Exclusive or.

nand Nand.

nor Nor.

xnor Exclusive nor.

bst Bit set.

bcl Bit clear.

bsw Byte swap.

Shifts and Rotates

The shift and rotate operations normally take two operands, a value and the number of bits to shift or rotate. However if immediately preceded by the **calc** prefix then they immediately shift or rotate the current value by one bit.

shl Logical shift left.

shr   Logical shift right.

sar   Arithmetic shift right.

rol   Rotate left.

ror   Rotate right.

Text and UTF

text   Text to UTF-8.
Brings up the keyboard so that you may enter characters to convert to UTF-8 coded character sequences. You may enter more than one character but the resulting UTF-8 coded character sequences must total eight or fewer bytes.

utf 8   UTF-8 to Text.
Interprets a numeric value as UTF-8 coded character sequences and displays the encoded characters.
If UTF-16 or UTF-32 character encodings are currently displayed then the coded character sequences are converted to UTF-8 character encodings. The coded character sequences must total eight or fewer bytes.

utf 16   UTF-16 to Text.
Interprets a numeric value as UTF-16 coded character sequences and displays the encoded characters.
If UTF-8 or UTF-32 character encodings are currently displayed then the coded character sequences are converted to UTF-16 character encodings. The coded character sequences must total eight or fewer bytes.

utf 32   UTF-32 to Text.
Interprets a numeric value as UTF-32 coded character sequences and displays the encoded characters.

If UTF-8 or UTF-16 character encodings are currently displayed then the coded character sequences are converted to UTF-32 character encodings. The coded character sequences must total eight or fewer bytes.
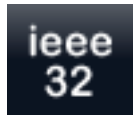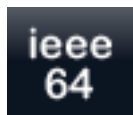
IEEE Floating Point

Value to IEEE 32.
If the current value is decimal then the value is converted to its IEEE single precision (32-bit) floating point encoding.
If the current value is hexadecimal, octal or binary then the value is interpreted as an IEEE single precision encoding and converted to a decimal value.
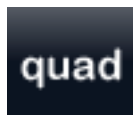
Value to IEEE 64.
If the current value is decimal then the value is converted to its IEEE double precision (64-bit) floating point encoding.
If the current value is hexadecimal, octal or binary then the value is interpreted as an IEEE double precision encoding and converted to a decimal value.

Dotted Quad

Value to dotted quad.
Displays the current value as a 32-bit dotted quad.

Colors

Value to RGBA and color.
Displays the current value as a 32-bit RGBA. RGBA components are shown as floating point values between 0.00 and 1.00.
A rectangle displaying the actual color represented by the RGBA value is shown next to the annunciators. The background of this rectangle consists of a white strip and a black strip, this is to help visualize the alpha component of the color.

Special Calculations
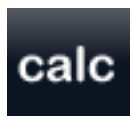
Calculate.
The calc prefix changes the operation performed by certain buttons.

calc = Converts the current value using the currently defined integer type and size.

calc **enter** Converts the current value using the currently defined integer type and size.

calc **shl** Logical shift left one bit.

calc **shr** Logical shift right one bit.

calc **sar** Arithmetic shift right one bit.

calc **rol** Rotate left one bit.

calc **ror** Rotate right one bit.

Worksheets

In addition to the traditional calculator functionality described above, hex worksheets offer a native iOS graphical interface where you may enter and edit data and view some of the more common hex operations.
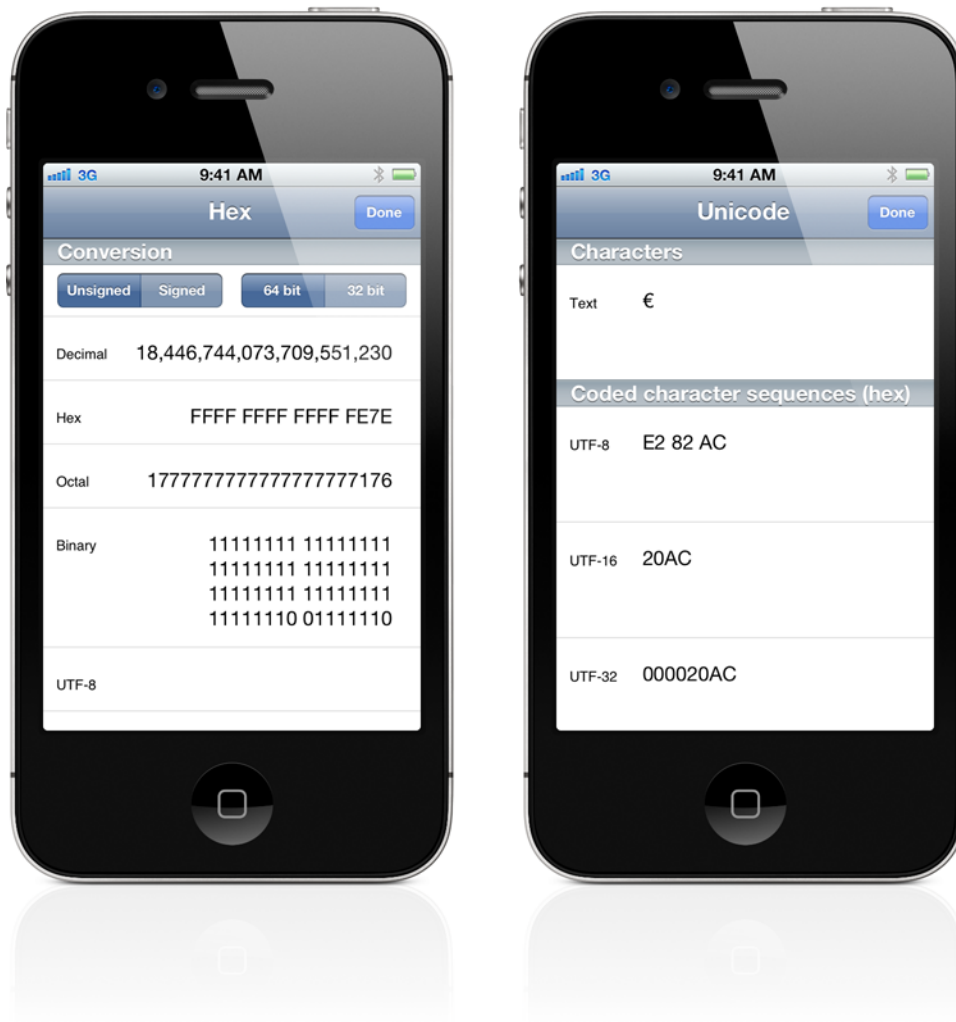
These operations include:

Hex

Unsigned / Signed
64 Bit / 32 Bit
Decimal Value
Hex Value
Octal Value
Binary Value
UTF-8 Text

Unicode

Text
UTF-8 Hex Encoding
UTF-16 Hex Encoding
UTF-32 Hex Encoding

To navigate to the hex worksheets press the info button on the calculator navigation bar to flip to the tape, worksheets, manual and settings.

Press the worksheets tab.

To flip back to the calculator press the done button on the navigation bar.

Bill / Tip Operations

(Included in Perpenso Calc, optional in Perpenso Calc 4)

Item List

Price	Qty	%	Amount
12.00	1	25	3.00
15.00	1	100	15.00
5.00	2	100	10.00

Sub		28.00
Tax	8.75%	2.45
Tip	15.00%	4.20
Total		34.65
Split	1	34.65

When the calculator is in bill mode the left half of the screen displays a list of items, subtotal, tax, tip, total, etc. The item list always has a column showing the final amount for each item. There are also optional columns showing the price, quantity and the percentage you are responsible for. To enhance readability the optional columns are only shown if they contain non-default values. The default quantity is 1 and the default percentage is 100%. The list scrolls up and down using flicking gestures.

Entering Numbers

item
Item price.
Enters the price of an item. By default the quantity for this item is one and your share of this item is 100%.

Items may also be entered and edited in the bill worksheet.

qty
Quantity.
Sets the quantity for the most recently entered item. For example if you purchase two of a $4.95 item enter:

4 **·** **9** **5** **item**
2 **qty**

Quantities may also be entered and edited in the bill worksheet.

pct Percent.
Sets your share of the most recently entered item. For example if you are responsible for 50% of a $9.95 item enter:

9 **·** **9** **5** **item**
5 **0** **pct** .

Percentages may also be entered and edited in the bill worksheet.

tax Tax.
Sets the tax rate and then the tax amount is calculated using this rate. If the button is pressed a second time then the number is used as the actual tax amount and the tax rate is calculated from this amount. Pressing the button a third time switches back to setting the rate. For example to set the tax rate to 10% enter:

1 **0** **tax**

Or to set the tax amount to 1.23 enter:

1 **·** **2** **3** **tax** **tax** .

Tax rates may also be edited in the bill worksheet.

tip Tip.
Sets the tip rate and then the tip amount is calculated using this rate. If the button is pressed a second time then the number is used as the actual tip amount and the tip rate is calculated from this amount. Pressing the button a third time switches back to setting the rate. For example to set the tip rate to 18% enter:

1 **8** **tip**

Or to set the tip amount to 5.00 enter:

5 **tip** **tip** .

Tip rates may also be edited in the bill worksheet.

up Round up.
Automatically increase the tip amount so that the total will be rounded up to a whole number.

split Split.
Sets the number of people to split the final bill amount between.

The split may also be edited in the bill worksheet.

Calculator Tape

tape Tape.
Sends the final itemized bill to the calculator tape.

Copy and Paste

A double tap near the bill total allows you to copy the bill.

Worksheet

In addition to the traditional calculator functionality described above, a bill worksheet offers a native iOS graphical interface where you may enter and edit data and view various bill amounts.
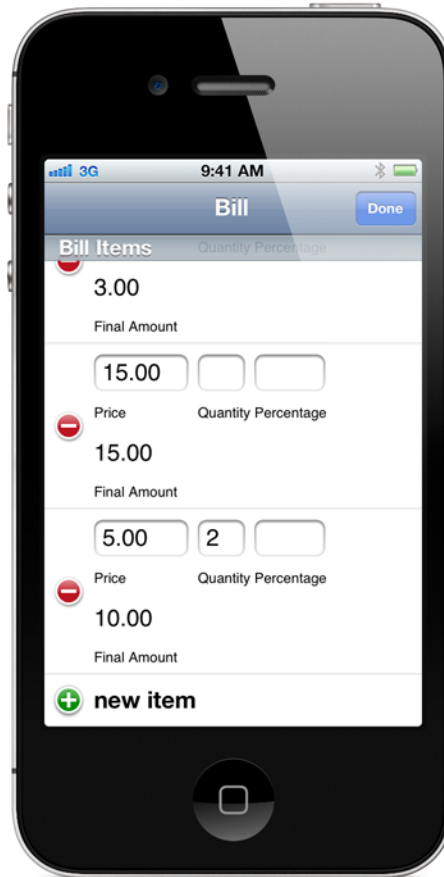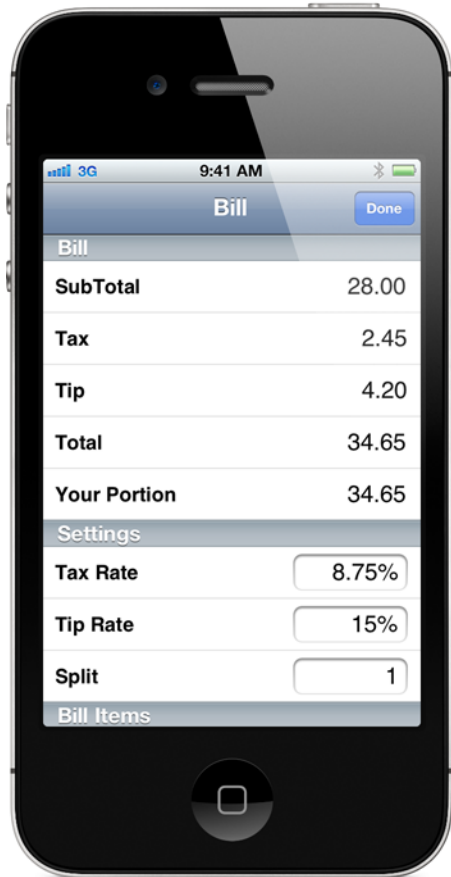
To navigate to the bill worksheet press the info button on the calculator navigation bar to flip to the tape, worksheets, manual and settings.

Press the worksheets tab.
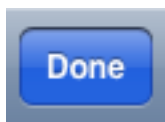
To flip back to the calculator press the done button on the navigation bar.

Calculator Tape

(Not available in lite mode)

The tape records the calculations performed.

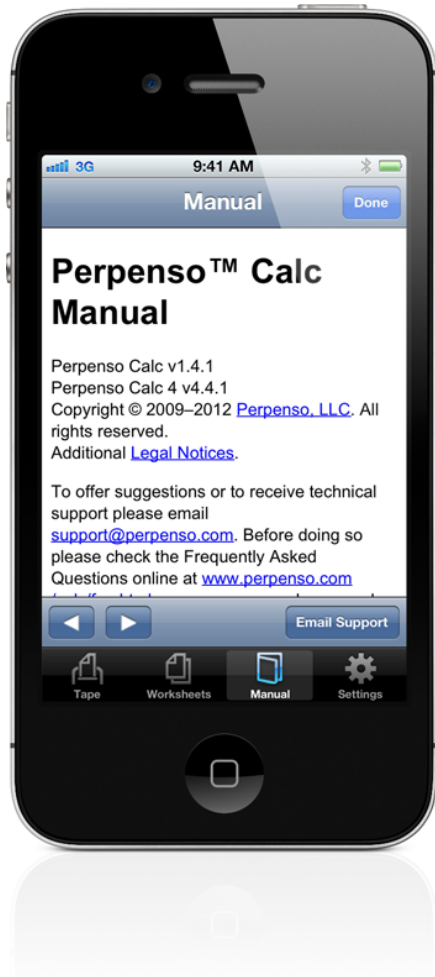The trash button on the navigation bar clears the tape.

The buttons on the toolbar allow you to select left or right positioning of operations.

A double tap on the tape entries allows you to copy the tape.

Calculator Manual

A simplified browser based version of this manual that is designed for the iPhone display is embedded into Perpenso Calc.

A pair of arrow buttons on the tool bar allow you to move back and forward through the manual links.

An email support button on the tool bar launches the Mail application and creates a message preconfigured with Perpenso's support email address.
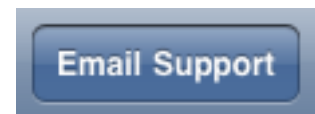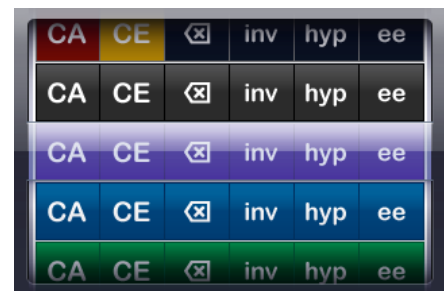
Calculator Settings

The restore button on the navigation bar restores all settings to their default values.

For reference a version number is shown.

Various calculator color schemes are available, except in lite mode. The current scheme is displayed, click on it to bring up a picker to change it.

The button flash switch enables a visible cue indicating when a calculator button is pressed.

The button click switch enables an audible cue indicating when a calculator button is pressed.

The calculator supports two order of operations modes: Chain and RPN. A check appears next to the current selection. To change the selection tap on the desired order of operations.

The clear all operation, , may be configured to reset or leave alone the memory registers, payment and compounding periods per year, and hex mode base (radix).

A precision setting allows you to control the number of fractional digits that are displayed. Only the display is affected, the internal representation of numbers will always use the maximum number of digits possible. The precision setting is overridden by the fixed decimal mode. Fixed decimal mode is similar to precision but fixed decimal will always display the designated number of digits and add trailing zeros if necessary.

Fixed decimal mode is controlled using the button on the calculator in scientific mode.

The thousands separator switch allows commas to be used to group integer digits.

Default tax and tip rates are available for bill functionality. Tap on the current value to bring up a picker that will let you change the rate.

The maximum denominator allows you to limit fractions to reasonable values. Fractions with denominators larger than the defined maximum will be displayed as decimal numbers. Tap on the current value to bring up a picker that will let you change the maximum denominator.

The conversion operations may be set to use US customary, US food nutrition or Imperial units. US food nutrition units are primarily used for labeling.

The tape maximum length limits the number of calculator operations that are recorded. Tap on the current value to bring up a picker that will let you change the maximum length.