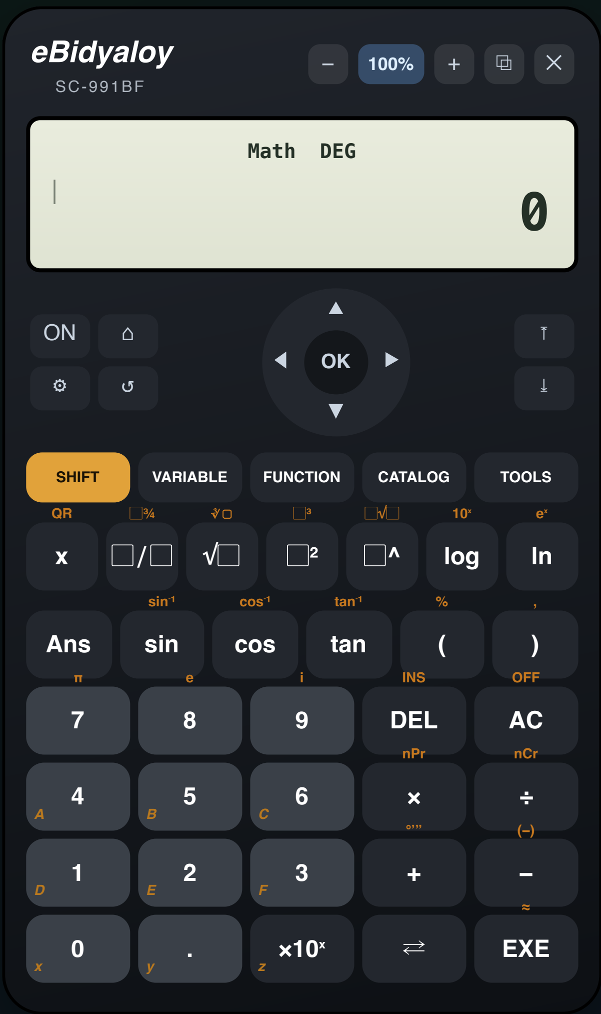
EBIDYALOY · SCIENTIFIC CALCULATOR EMULATOR

SC-991BF

Windows · macOS · Web · Android · iOS



Complete User's Guide & Function Reference — everything you need to operate the SC-991BF scientific calculator emulator, with every example result computed by the calculator engine.

Contents

About This Guide

Welcome

SC-991BF Emulator

The **eBidyaloy SC-991BF** is an on-screen scientific calculator emulator for classrooms and study — available on **Windows, macOS, Web, Android and iOS**. It reproduces a modern ClassWiz-style scientific calculator: a natural "textbook" display, 13 calculator apps, physical constants, unit conversions, and a live step-by-step explainer for teaching.

> Throughout this guide, every worked **Example** shows the expression, the calculator display, and the exact key operation. All results are produced by the actual SC-991BF calculation engine, so what you read here is what the emulator computes.

How to read the key operations

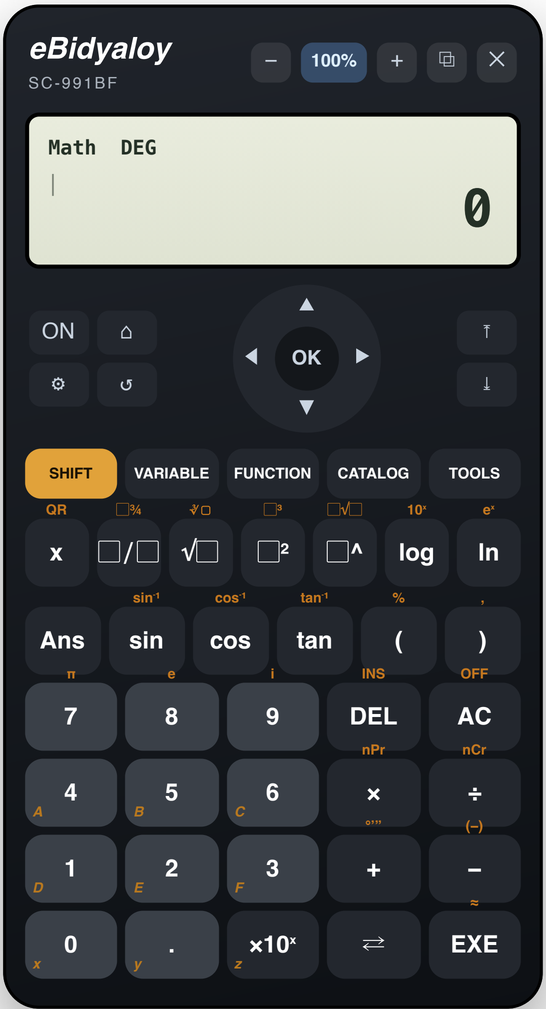
Key presses are shown as chips, e.g. 7 × 8 EXE. A key's **SHIFT** function (orange label above the key) is written SHIFT then the key; a **VARIABLE** letter (gold) is entered from the VARIABLE menu.

Keys & Key Markings

The Faceplate

Zones

The SC-991BF keypad is arranged in the same zones as a modern scientific calculator: a title strip, the LCD, a control cluster, five soft keys, two scientific rows, and the number pad.



Key Markings — three functions per key

Most keys have up to three functions: 7 **Primary** — printed on the key; press it directly. π **SHIFT** — the orange label above the key; press SHIFT first, then the key. *A* **VARIABLE** — the gold letter; entered from the VARIABLE menu. For example, SHIFT 7 inputs **π**, and SHIFT sin inputs **$\sin^{-1}$**.

Control Cluster

Key	Function
ON	Turns the calculator on and clears the current entry (AC also clears).
⌂ HOME	Opens the HOME screen — the menu of all calculator apps.
⚙ SETTINGS	Opens the SETTINGS menu (Calc Settings and Reset).

↺ Back	Deletes the character before the cursor, or steps back one menu level.
▲ ▼ ◀ ▶	Cursor keys — move the entry cursor, or move the highlight in menus and tables.
OK	Executes the calculation or selects the highlighted menu item (same as EXE).
⤒ ⤓	Page keys — jump to the top / bottom of a long result, menu, table or list.

Soft Keys

Soft key	Opens
SHIFT	Selects the alternate (orange) function printed above the next key you press.
VARIABLE	The variable menu — recall or store the memories A, B, C, D, E, F, x, y, z and M (M also has M+ / M–).
FUNCTION	A function menu for the current app (e.g. Abs, arg, Conjg, ReP, ImP for complex work).
CATALOG	The CATALOG of commands and functions, plus **CONST** ▸ (physical constants) and **CONV** ▸ (unit conversions).
TOOLS	Result tools: S⇔D, Prime Factor, Recurring Decimal, Sexagesimal (° ’ ”) and Improper Fraction.

Scientific Keys

Key	SHIFT	Function
x	QR	Inserts the variable **x**.
□/□	□¾	Fraction template a⁄b. SHIFT inserts a mixed-number template.
√□	∛□	Square root. SHIFT inserts a cube root.
□²	□³	Square (x^2). SHIFT cube (x^3).
□^	□√□	Power x^y. SHIFT the x-th root of a value.
log	10^x	Common logarithm (base 10). SHIFT raises 10 to a power.
ln	e^x	Natural logarithm (base e). SHIFT raises e to a power.
Ans	—	Inserts the previous answer.
sin	$\sin^{-1}$	Sine. SHIFT arcsine (inverse).
cos	$\cos^{-1}$	Cosine. SHIFT arccosine (inverse).
tan	$\tan^{-1}$	Tangent. SHIFT arctangent (inverse).
(	%	Open parenthesis. SHIFT the percent operator.
)	,	Close parenthesis. SHIFT a comma (argument separator).

Number Pad

Key	SHIFT	VARIABLE	Function
7 8 9	π e i	—	Digits. SHIFT: 7→π, 8→e, 9→i (imaginary unit).
4 5 6	—	A B C	Digits, or recall variables A / B / C via VARIABLE.

1 2 3	—	D E F	Digits, or recall variables D / E / F via VARIABLE.
0 .	—	x y	Digit / decimal point, or variables x / y.
DEL	INS	—	Deletes at the cursor. SHIFT toggles insert mode.
AC	OFF	—	All clear. SHIFT turns the calculator off.
×	nPr	—	Multiply. SHIFT permutation (nPr).
÷	nCr	—	Divide. SHIFT combination (nCr).
+	° ’ ”	—	Add. SHIFT sexagesimal (degrees-minutes-seconds) entry.
−	(−)	—	Subtract. SHIFT the negative sign for a signed value.
$\times10^x$	—	z	Enters a power-of-ten exponent (scientific entry). VARIABLE: z.
⇄ (FORMAT)	—	—	S⇔D: toggles the result between decimal and exact (fraction / √ / π) form. Opens the FORMAT menu when set to do so.
EXE	≈	—	Executes the calculation. SHIFT forces a decimal (≈) result.

Menu-Operation Shorthand

To keep instructions short, this guide writes menu paths in a compact form. For example:

⚙ – [Calc Settings] > [Angle Unit] > [Degree]

…is the same as the full operation:

1. Press ⚙.
2. Use ▲ ▼ to select **[Calc Settings]**, then press OK.
3. Select **[Angle Unit]**, then press OK.
4. Select **[Degree]**, then press OK.

Note

Where a menu item shows an option number to its left, you can also press that number key to jump straight to the item — see **Using Menus**.

Entering & Editing Calculations

Entering a Calculation

Natural textbook input

The SC-991BF uses a **natural textbook display** (MathI/MathO): fractions, roots, powers and other expressions appear on screen just as they are written on paper. You type an expression from left to right and press **EXE** to evaluate it.

Keys such as **□/□** (fraction), **√□** (root) and **□^** (power) insert an empty **template** with boxes to fill. Type into the highlighted box, and press **▶** to move out of it and continue the calculation.

Example 1 To enter $1\frac{1}{2} + \sqrt{4}$

SHIFT **□/□** 1, 1, 2 **▶** **+** **√□** 4 **▶** **EXE**

```
Math DEG
1½ + √4

     3.5
```

The mixed-number template **SHIFT** **□/□** creates three boxes (whole, numerator, denominator); **▶** steps out of the root before **EXE**. The result 1.5 + 2 = 3.5 is shown.

Editing a Calculation

Cursor, insert & delete

Moving the cursor

Use the arrow keys to move the flashing cursor through an expression without erasing anything:

Key	Movement
◀ ▶	Move left / right one item along the current line.
▲ ▼	Move between levels of a template — for example up into the numerator of a fraction or down into the denominator.

Deleting and inserting

To correct a mistake, move the cursor to the spot and use:

Key	Action
DEL	Delete the item immediately to the **left** of the cursor.
SHIFT DEL (INS)	Toggle between **insert** mode (new input pushes existing items right) and **overwrite** mode.
AC	Clear the whole expression and start again.

Example 2 To fix 7 × 9 typed as 7 × 8

◀ **DEL** 9 **EXE**

```
Math DEG
7 × 9

   63
```

With the cursor after the 8, press **DEL** to remove it, type 9, then **EXE**. Only the wrong digit is changed — the rest of the expression is untouched.

Note

The calculator inserts by default, so you rarely need overwrite mode. If new characters seem to replace what is already there, press SHIFT DEL (INS) once to switch back to insert.

Correcting after a result

After you press EXE and see a result, you have two choices:

- Begin a **new** calculation — just start typing, and the previous entry is cleared.
- **Edit** the previous entry — press ◀ or ▶ to bring the expression back with the cursor in it, change what you need, and press EXE again.

Calculation History

Recall & replay

The calculator keeps your last **30** calculations. From a result, press ▲ to step back through previous entries and ▼ to step forward. A recalled entry can be re-used in two ways:

- Press EXE to **re-run** the recalled calculation as it is.
- Move the cursor into it, **edit** the expression, then press EXE to evaluate the changed version.

Example 3 To recall and re-run a previous calculation

at a result → ▲ browse → EXE re-run

```
Math DEG
7 × 8 − 4 × 5
           36
```

Pressing ▲ brings back an earlier entry such as 7 × 8 – 4 × 5; EXE evaluates it again. Editing it first lets you try a variation without retyping the whole line.

Important!

Calculation history is cleared when you switch to a different app or reset the calculator. Use a **variable** (Store into A–F, x, y, z, M) to keep a value you will need after leaving the app.

Reusing the last answer with Ans

The result of the most recent calculation is held in **Ans**. Start a new calculation with an operator (for example + or ×) and the calculator inserts **Ans** automatically, or press Ans to use it anywhere in an expression.

Example 4 To chain calculations with Ans

1000 − 200 EXE → × 2 EXE

```
Math DEG
Ans × 2
   1600
```

After 1000 – 200 = 800, pressing × 2 continues from that answer: Ans × 2 = 1600. This lets you build up a long calculation one step at a time.

Using Menus & Settings

Using Menus

Navigation

Many operations use menu screens. Press ⚙ while using a calculator app to open the SETTINGS menu shown below. Each item with a ▸ opens a further menu.

```
❶ Calc Settings   ▸
❷ Reset           ▸
```

Two ways to select an item:

- **Method 1** — use ▲ ▼ to move the highlight, then press OK.
- **Method 2** — press the number key shown to the left of the item (its **option number**). For example, press 2 to open **Reset** directly.

Press ↺ to step back one level, or AC to leave the menu.

Note

Option numbers (❶ ❷ ❸ …) let you jump to an item even before its menu is showing. Pressing ⚙ on the HOME screen opens Get Started instead of SETTINGS.

Using the SETTINGS Menu

Calc Settings & Reset

The SETTINGS menu has two groups: **Calc Settings** (how calculations behave and display) and **Reset**. Drill in with OK; each setting shows a numbered list of options to choose from.

```
Calc Settings
❶ Input/Output      ▸
❷ Angle Unit        ▸
❸ Number Format     ▸
❹ Fraction Result   ▸
```

```
Angle Unit
❶ Degree
❷ Radian
❸ Gradian
```

Calc Settings

Setting	Options	What it does
Input/Output	MathI/MathO	Natural textbook entry and display — fractions, roots and powers appear in two-dimensional form.
Angle Unit	Degree · Radian · Gradian	The angle unit used by trigonometric functions and their results.
Number Format	Norm 1 · Norm 2 · Fix 0–9 · Sci 1–10	How results are shown. Norm switches to exponential outside a range (Norm 1 switches sooner); Fix fixes the number of decimal places; Sci fixes the number of significant figures.
Fraction Result	Improp Fraction · Mixed Number	Whether a fractional answer shows as an improper fraction (7⁄3) or a mixed number (2 1⁄3).

Complex Result	a+bi · r∠θ	Whether a complex answer shows in rectangular (a + bi) or polar (r∠θ) form.
FORMAT Key	Decimal · Format Menu	What the ⇄ FORMAT key does — toggle straight to decimal, or open the FORMAT menu of display options.
Digit Separator	On · Off	Thousands grouping in results, e.g. 1,234,567.
Decimal Mark	Dot · Comma	The decimal character and matching grouping: 1,234.5 (Dot) or 1.234,5 (Comma).

Example — set the angle unit to Degree: ⚙ – [Calc Settings] > [Angle Unit] > [Degree]. Trigonometric calculations now use degrees.

Reset

Reset item	What it does
Settings & Data	Returns all settings to their defaults and clears app data.
Variable Memory	Clears the variables A, B, C, D, E, F, x, y, z and M.
Initialize All	Resets everything — settings, memory and data.

Note

A reset cannot be undone. **Settings & Data** and **Initialize All** clear your work, so use them deliberately.

Using the CATALOG

Using the CATALOG Menu

Commands & Functions

Press **CATALOG** to open a scrollable list of the commands, functions and symbols available in the current app. Move the highlight with ▲ ▼ and press **OK** to insert the selected item; press ↺ to close.

```
CATALOG
   d/dx( derivative
   ∫( integral
   Σ( summation
   GCD(  LCM(
   CONST ▸                    ▸
   CONV ▸                     ▸
```

Two entries open sub-menus: **CONST ▸** (physical constants) and **CONV ▸** (unit conversions). Everything else is inserted straight into your calculation.

> **Note**
> On the SC-991BF, CATALOG is a single combined list of commands (plus the CONST ▸ and CONV ▸ sub-menus). The groups in the table below are a reading aid — on-screen you simply scroll one list.

CATALOG commands

Group	Commands available from CATALOG
Function Analysis	d/dx(derivative · ∫(integral · Σ(summation · Π(product · log□(□) log to any base · x^{-1} reciprocal · x! factorial
Numeric	GCD(· LCM(· RanInt#(random integer · Pol(rectangular→polar · Rec(polar→rectangular · Abs · Int/Frac/Intg/Rnd
Hyperbolic	sinh · cosh · tanh · $\sinh^{-1}$ · $\cosh^{-1}$ · $\tanh^{-1}$
Special operations	SOLVE (f(x)=0) · CALC (evaluate with variables) · FACT (prime factorise) · ENG / ENG→ (engineering form) · RECUR (recurring decimal) · VERIFY (test a relation)
Symbols	: multi-statement · → store to variable · =, ≠, <, >, ≤, ≥ relations · $^{\circ}$ ^{r} ^{g} angle units
Matrix / Vector	MatA–MatD, MatAns · VctA–VctD, VctAns · det(· Trn(transpose · Identity(
Reference ▸	CONST ▸ 47 physical constants (6 categories) · CONV ▸ 40 unit conversions (9 categories)

CONST — Physical Constants

CATALOG → CONST ▸

CONST ▸ opens a menu of 47 scientific constants (CODATA-2022) organised into six categories. Choose a category, then a constant, to insert its symbol and value into your calculation.

```
CONST
❶ Universal ▸
❷ Electromagnetic ▸
❸ Atomic & Nuclear ▸
❹ Physico-Chem ▸
```

For example, inserting **c** (speed of light) inserts the value 299 792 458. The complete list appears in the **Constants & Conversions** reference chapter.

CONV — Unit Conversions

CATALOG → CONV ▸

CONV ▸ applies a unit conversion to the value currently on the display. First compute a value, then choose a category and a conversion; the result is replaced by the converted value.

```
UNIT CONVERT
❶ Length ▸
❷ Area ▸
❸ Volume ▸
❹ Mass ▸
```

There are 40 conversions across nine categories (Length, Area, Volume, Mass, Velocity, Pressure, Energy, Power, Temperature). The full list is in the reference chapter.

Example — greatest common divisor from CATALOG

To compute the GCD of 12 and 18:

```
GCD(12, 18)
                                        6
```

CATALOG › GCD(› 1 › 2 › , › 1 › 8 ›) › EXE

Result: **GCD(12, 18) = 6**. The same menu provides LCM, random integers, and the Pol/Rec coordinate conversions.

Calculator Apps

Selecting a Calculator App

HOME screen

Press ⌂ to display the HOME screen — the menu of all installed calculator apps. Use ▲ ▼ ◀ ▶ to move the highlight to an app, then press OK. Alternatively, press the number key shown on an app's icon (its option number) to open it directly.

1 ×÷ Calculate	2 Statistics	3 ▦ Table
4 X= Equation	5 X> Inequality	6 ⌒ Distribution
7 i Complex	8 [▦] Matrix	9 → Vector
10 ⊞ Spreadsheet	11 a:b Ratio	12 ⚄ Math Box
13 0x Base-N		

Note

Each app remembers its own screen, data and CATALOG. Switching apps does not clear another app's data.

Installed Calculator App List

13 apps

App	Description
1 ×÷ Calculate	General and scientific calculations — arithmetic, functions, powers, roots, logs, complex numbers and every CATALOG command.
2 Statistics	1- and 2-variable statistics and seven regression models, with a data-entry table and a full set of summary results.
3 ▦ Table	Generates a table of values from one or two functions, f(x) and g(x), over a start/end/step range.
4 X= Equation	Solves simultaneous linear equations (2 to 4 unknowns) and polynomial equations (quadratic, cubic, quartic).

5 x> Inequality	Solves quadratic, cubic and quartic inequalities and reports the solution intervals.
6 ⌒ Distribution	Normal, Binomial and Poisson probability — both probability density (PD) and cumulative distribution (CD).
7 i Complex	Dedicated complex-number arithmetic with rectangular (a + bi) and polar (r∠θ) results.
8 [▦] Matrix	Matrix arithmetic up to 4×4 — addition, subtraction, multiplication, determinant, inverse and transpose.
9 → Vector	2D and 3D vector operations — dot product, cross product, magnitude, angle and unit vectors.
10 ⊞ Spreadsheet	A 5-column (A–E) × 45-row spreadsheet with cell formulas, fill/copy tools and range functions (Sum, Min, Max, Mean).
11 a:b Ratio	Solves proportions of the form a : b = c : x for the unknown term.
12 ⚄ Math Box	Probability and learning tools — dice roll, coin toss, number line and circle simulations.
13 0x Base-N	Binary, octal, decimal and hexadecimal calculations with logic operators (and, or, xor, not).

App Screens at a Glance

Entry screens

When you open an app you see either a calculation screen or a short menu to choose the calculation type. Each app is documented in full — every function with worked examples — in the chapters that follow.

1 ×÷ Calculate

APP 1

Calculate

General and scientific calculations — arithmetic, functions, powers, roots, logs, complex numbers and every CATALOG command.

```
Math DEG

                                   0
```

APP 2

Statistics

1- and 2-variable statistics and seven regression models, with a data-entry table and a full set of summary results.

```
Statistics
❶ 1-Variable
❷ y=a+bx
❸ y=a+bx+cx²
```

APP 3

Table

Generates a table of values from one or two functions, f(x) and g(x), over a start/end/step range.

```
Table
f(x)=
```

APP 4

Equation

Solves simultaneous linear equations (2 to 4 unknowns) and polynomial equations (quadratic, cubic, quartic).

```
Equation
❶ Simult. Equation
❷ Polynomial
```

APP 5

Inequality

Solves quadratic, cubic and quartic inequalities and reports the solution intervals.

```
Inequality
❶ Order 2 (ax²…)
❷ Order 3
❸ Order 4
```

6 ⌒ Distribution

APP 6

Distribution

Normal, Binomial and Poisson probability — both probability density (PD) and cumulative distribution (CD).

```
Distribution
❶ Normal PD
❷ Normal CD
❸ Binomial PD
```

7 i Complex

APP 7

Complex

Dedicated complex-number arithmetic with rectangular (a + bi) and polar (r∠θ) results.

```
Math Complex
                                        0
```

8 [▦] Matrix

APP 8

Matrix

Matrix arithmetic up to 4×4 — addition, subtraction, multiplication, determinant, inverse and transpose.

```
Matrix
❶ Define MatA
❷ Define MatB
❸ MatA + MatB
```

9 → Vector

APP 9

Vector

2D and 3D vector operations — dot product, cross product, magnitude, angle and unit vectors.

```
Vector
❶ Define VctA
❷ Define VctB
❸ VctA · VctB
```

Spreadsheet

APP 10
Spreadsheet
A 5-column (A–E) × 45-row spreadsheet with cell formulas, fill/copy tools and range functions (Sum, Min, Max, Mean).

```
Spreadsheet
A1
```

a:b
Ratio

APP 11
Ratio
Solves proportions of the form a : b = c : x for the unknown term.

```
Ratio
❶ a:b = c:x
❷ a:b = x:d
```

Math Box

APP 12
Math Box
Probability and learning tools — dice roll, coin toss, number line and circle simulations.

```
Math Box
❶ Dice Roll
❷ Coin Toss
❸ Number Line
```

0x
Base-N

APP 13
Base-N
Binary, octal, decimal and hexadecimal calculations with logic operators (and, or, xor, not).

```
Base-N DEC
0
```

Extended Display & Explainer

The Extended Display

Presentation mode

When teaching with the SC-991BF on a large screen, open the **extended display** with the ⧉ (cast) button in the title bar. A greatly enlarged copy of the calculator's LCD appears beside the keypad so the whole class can read the current expression and result. The panel is marked **LIVE DISPLAY** and refreshes automatically as you type.

> Use the size controls (− % +) to fit the calculator to any display, and press **HIDE** to collapse the panel. The extended display always mirrors exactly what is on the calculator's own screen.

The Explainer

EXPLANATION & STEPS

Below the extended display, the **explainer** turns any Calculate result into a lesson. It has two tabs:

- **EXPLANATION** — a plain-language walkthrough of what each function and operation does, in order.
- **STEPS** — the working shown as a reduction: the expression is rewritten one step at a time, each line a little more simplified, down to the final answer (shown in green).

> **Note**
> The explainer is available in the Calculate app for any expression you evaluate. Both the wording and the step chain are produced by the calculator itself — they always match the actual computation.

Example 1 — roots and arithmetic

eBidyaloy · EXTENDED DISPLAY

● LIVE DISPLAY

Math DEG

2×√(2)+3

5.8284271248

EXPLANATION STEPS

EXPLANATION

A square root asks: which number, multiplied by itself, gives 2? Since 1.4142135624 × 1.4142135624 = 2, we get √2 = 1.4142135624.

Multiply 2 by 1.4142135624: 2 × 1.4142135624 = 2.8284271248.

Add 2.8284271248 and 3 together: 2.8284271248 + 3 = 5.8284271248.

STEPS

```
2×√(2)+3
√2 = 1.4142135624
= 2 × 1.4142135624 = 2.8284271248
= 2.8284271248 + 3 = 5.8284271248
```

Example 2 — trigonometry (Degree)

eBidyaloy · EXTENDED DISPLAY ● LIVE DISPLAY

Math DEG

```
sin(30)+cos(60)
```

1

EXPLANATION | STEPS

EXPLANATION

sin gives sine of the angle. Here sin(30°) = 0.5.

cos gives cosine of the angle. Here cos(60°) = 0.5.

Add 0.5 and 0.5 together: 0.5 + 0.5 = 1.

STEPS

```
sin(30)+cos(60)
sin(30°) = 0.5
= cos(60°) = 0.5
= 0.5 + 0.5 = 1
```

Example 3 — powers

eBidyaloy · EXTENDED DISPLAY ● LIVE DISPLAY

Math DEG

```
3^2+4^2
```

25

EXPLANATION | STEPS

EXPLANATION

Squaring means multiplying a number by itself. So $3^2 = 3 \times 3 = 9$.

Squaring means multiplying a number by itself. So $4^2 = 4 \times 4 = 16$.

Add 9 and 16 together: 9 + 16 = 25.

STEPS

```
3^2+4^2
3² = 9
= 4² = 16
= 9 + 16 = 25
```

Example 4 — logarithms

eBidyaloy · EXTENDED DISPLAY ● LIVE DISPLAY

Math DEG

log(1000)+ln(1)

3

EXPLANATION STEPS

EXPLANATION

log gives logarithm (base 10). Here log(1,000) = 3.

ln gives natural logarithm (base e). Here ln(1) = 0.

Add 3 and 0 together: 3 + 0 = 3.

STEPS

```
log(1000)+ln(1)
log(1,000) = 3
= ln(1) = 0
= 3 + 0 = 3
```

Example 5 — implicit multiplication priority

eBidyaloy · EXTENDED DISPLAY ● LIVE DISPLAY

Math DEG

6÷2(1+2)

1

EXPLANATION STEPS

EXPLANATION

Divide 6 by 2 — splitting 6 into 2 equal parts: 6 ÷ 2 = 3.

Add 1 and 2 together: 1 + 2 = 3.

Multiply 3 by 3 (writing them side by side means multiply): 3 × 3 = 1.

STEPS

```
6÷2(1+2)
6 ÷ 2 = 3
= 1 + 2 = 3
= 3 × 3 = 1
```

Example 6 — order of operations

eBidyaloy · EXTENDED DISPLAY

● LIVE DISPLAY

Math DEG

7+3×4−2

17

EXPLANATION | STEPS

EXPLANATION

Multiply 3 by 4: 3 × 4 = 12.

Add 7 and 12 together: 7 + 12 = 19.

Subtract 2 from 19: 19 − 2 = 17.

STEPS

7+3×4−2

3 × 4 = 12

= 7 + 12 = 19

= 19 − 2 = 17

Calculate App Reference

Calculate

General & scientific calculation

The **Calculate** app is the calculator's main workspace. Enter an expression in natural textbook format and press EXE to evaluate it. This chapter covers every function available in Calculate, grouped by type, each with a worked example.

> **Note**
>
> Unless a note says otherwise, examples assume the default settings — Angle Unit: Degree, and MathI/MathO input/output.

Basic Arithmetic & Priority

Use + − × ÷ for the four operations and ( ) to group terms. Calculations follow standard priority: functions and powers first, then × ÷, then + −. An omitted × (implicit multiplication) before a bracket or constant binds tighter than ÷.

Example 1 To calculate 7 × 8 – 4 × 5

7 × 8 − 4 × 5 EXE

```
Math DEG
7 × 8 − 4 × 5
           36
```

Multiplication is done before subtraction: 56 – 20 = 36.

Example 2 To calculate 6 ÷ 2(1 + 2)

6 ÷ 2 (1 + 2) EXE

```
Math DEG
6 ÷ 2(1 + 2)
            1
```

Implicit multiplication binds tighter than ÷, so this reads 6 ÷ (2 × (1 + 2)) = 6 ÷ 6 = 1.

Fractions

Press □/□ for a fraction template and SHIFT □/□ for a mixed number. Results appear as fractions; press ⇄ (FORMAT) to switch to a decimal.

Example 3 To calculate 3⁄4 + 1⁄6

3 □/□ 4 ▶ + 1 □/□ 6 EXE

```
Math DEG
3⁄4 + 1⁄6
0.9166666667
```

The exact result is shown as the fraction 11⁄12. Press ⇄ to see it as the decimal 0.9166666667.

Powers & Roots

[□²] squares, [SHIFT] [□²] cubes, [□^] raises to any power, [√□] is a square root, [SHIFT] [√□] a cube root, and [SHIFT] [□^] gives the x-th root.

Example 4 To calculate $5^2 + 12^2$

5 [□²] [+] 1 2 [□²] [EXE]

```
Math DEG
5² + 12²
169
```

25 + 144 = 169. (Its square root, 13, is the hypotenuse of a 5-12-13 triangle.)

Example 5 To calculate the 5th root of 32

SHIFT [□^] 5 [▶] 3 2 [EXE]

```
Math DEG
⁵√32
2
```

The x-th root key gives $\sqrt[5]{32} = 2$, because $2^5 = 32$.

Example 6 To calculate 4^{-1} (reciprocal)

4 [CATALOG] [x⁻¹] [EXE]

```
Math DEG
4⁻¹
0.25
```

The reciprocal $\mathbf{x^{-1}}$ is 1 ÷ x, so $4^{-1} = 0.25$.

Exponential & Logarithmic

[log] is base-10 log, [ln] is natural log, [SHIFT] [log] is 10^x, [SHIFT] [ln] is e^x. Use the CATALOG **log□(□)** for a logarithm to any base.

Example 7 To calculate log 1000

log 1 0 0 0 [)] [EXE]

```
Math DEG
log 1000
3
```

log 1000 = 3, because $10^3 = 1000$.

Example 8 To calculate $\log_2 32$ (log to base 2)

[CATALOG] [log□(□)] → 2, 32 → [EXE]

```
Math DEG
log₂ 32
5
```

Enter the base in the small box: $\log_2 32 = 5$, because $2^5 = 32$.

Example 9 To calculate ln e^3 (natural logarithm)

ln e □^ 3 ▶) EXE

```
Math DEG
ln e³
        3
```

ln is the natural logarithm (base e). It undoes e^x, so ln e^3 = 3.

Example 10 To calculate e^2 (e^x)

SHIFT ln 2) EXE

```
Math DEG
e²
7.3890560989
```

SHIFT ln inputs e^x (e raised to a power): $e^2 \approx 7.3891$.

Trigonometric Functions

sin cos tan and their inverses (SHIFT + the key) use the current Angle Unit. Append ° ʳ ᵍ (from CATALOG) to give a value in a specific unit regardless of the mode.

Example 11 To calculate sin 30° (Degree mode)

sin 3 0) EXE

```
Math DEG
sin 30°
      0.5
```

In Degree mode sin 30° = 0.5.

Example 12 To calculate $\tan^{-1}$ 1 (Degree mode)

SHIFT tan 1) EXE

```
Math DEG
tan⁻¹ 1
       45
```

The inverse tangent of 1 is the angle whose tangent is 1: 45°.

Hyperbolic Functions

The hyperbolic functions sinh, cosh, tanh and their inverses are on the CATALOG menu.

Example 13 To calculate sinh 1

CATALOG sinh 1) EXE

```
Math DEG
sinh 1
1.1752011936
```

sinh 1 = (e – e^{-1}) / 2 ≈ 1.1752.

Percentage

Enter a value followed by SHIFT ((the % operator). A percentage is interpreted as “per hundred”.

Example 14 To calculate 150 × 20%

1 5 0 × 2 0 SHIFT (EXE

```
Math DEG
150 × 20%
30
```

20% of 150 is 30.

Permutation, Combination & Factorial

SHIFT × is nPr, SHIFT ÷ is nCr, and **x!** (factorial) is on the CATALOG menu.

Example 15 To calculate 5 P 2 (permutations)

5 SHIFT × 2 EXE

```
Math DEG
5 P 2
20
```

The number of ordered arrangements of 2 from 5 is 20.

Example 16 To calculate 8 C 3 (combinations)

8 SHIFT ÷ 3 EXE

```
Math DEG
8 C 3
56
```

The number of unordered selections of 3 from 8 is 56.

Example 17 To calculate 5! (factorial)

5 CATALOG x! EXE

```
Math DEG
5!
120
```

The factorial **x!** multiplies every whole number down to 1: 5! = 5 × 4 × 3 × 2 × 1 = 120.

Numeric Functions

The CATALOG provides **Abs** (absolute value), **Int** (truncate), **Frac** (fractional part), **Intg** (floor), **Rnd** (round to the display) and $\mathbf{x^{-1}}$ (reciprocal).

Example 18 To calculate |2 – 7| (absolute value)

FUNCTION Abs 2 – 7) EXE

```
Math DEG
|2 − 7|
5
```

The absolute value strips the sign: |–5| = 5.

Example 19 Int, Frac & Intg — the parts of –3.5

CATALOG Int –3.5) EXE

```
Math DEG
Int(−3.5)   Frac(−3.5)   Intg(−3.5)
−3 −0.5 −4
```

Int truncates toward zero (–3), **Frac** keeps the fractional part (–0.5), and **Intg** takes the floor — the largest integer not above the value (–4).

Example 20 Rnd — round off 2 ÷ 3

CATALOG Rnd 2 ÷ 3) EXE

```
Math DEG
Rnd(2 ÷ 3)
0.6666666667
```

Rnd rounds the value to the calculator's 10-digit display precision, discarding the internal guard digits it normally keeps.

GCD, LCM & Random

From the CATALOG: **GCD(**, **LCM(**, **RanInt#(** (a random integer in a range) and **Ran#** (a random number in [0, 1)).

Example 21 To calculate GCD(48, 36)

CATALOG **GCD(** 48, 36 → **EXE**

```
Math DEG
GCD(48, 36)
12
```

The greatest common divisor of 48 and 36 is 12.

Example 22 To calculate LCM(6, 8)

CATALOG **LCM(** 6, 8 → **EXE**

```
Math DEG
LCM(6, 8)
24
```

The least common multiple of 6 and 8 is 24.

Example 23 RanInt#(— a random integer from 1 to 6 (a dice roll)

CATALOG **RanInt#(** 1, 6 **)** **EXE**

```
Math DEG
RanInt#(1, 6)
4
```

Each press returns a fresh whole number between 1 and 6 — **your value will differ**. **Ran#** (no arguments) instead gives a random decimal in [0, 1).

Calculus — Derivative & Integral

The CATALOG offers **d/dx** (numerical derivative at a point) and **∫dx** (definite integral between limits).

Example 24 To calculate d/dx(x^2) at x = 3

CATALOG **d/dx** → x^2, at 3 → **EXE**

```
Math DEG
d/dx (x²)|₃
6
```

The slope of x^2 at $x = 3$ is $2x = 6$.

Example 25 To calculate ∫ x^2 dx from 0 to 1

CATALOG **∫dx** → x^2, 0, 1 → **EXE**

```
Math DEG
∫₀¹ x² dx
0.3333333333
```

The area under x^2 from 0 to 1 is $1⁄3 \approx 0.3333$.

Summation & Product

Σ sums and **Π** multiplies an expression as a counter runs from a lower to an upper limit.

Example 26 To calculate Σ x for x = 1 to 10

CATALOG Σ → x, 1, 10 → EXE

```
Math DEG
Σ x  (1 → 10)
            55
```

1 + 2 + … + 10 = 55.

Example 27 To calculate Π x for x = 1 to 5

CATALOG Π → x, 1, 5 → EXE

```
Math DEG
Π x  (1 → 5)
          120
```

1 × 2 × 3 × 4 × 5 = 5! = 120.

SOLVE, CALC & VERIFY

SOLVE finds a root of f(x) = 0 by Newton's method. **CALC** evaluates an expression after prompting for each variable. **VERIFY** tests whether a relation (=, ≠, <, >, ≤, ≥) is true.

Example 28 SOLVE — a root of $x^2 - 4 = 0$

x □² – 4 CATALOG SOLVE EXE

```
Math DEG
x² − 4 = 0
   x = 2
```

SOLVE searches from the stored x and finds the nearby root x = 2.

Example 29 CALC — evaluate 2A + B with A = 3, B = 4

2 VARIABLE A + VARIABLE B CATALOG CALC

```
Math DEG
2A + B
    10
```

CALC prompts for A then B, then evaluates 2·3 + 4 = 10.

Example 30 VERIFY — is 3 × 4 = 12 ?

3 × 4 CATALOG VERIFY = 12 EXE

```
Math DEG
3 × 4 = 12
     True
```

VERIFY confirms the relation is True.

Coordinate Conversion

Pol(converts rectangular (x, y) to polar (r, θ); **Rec(** converts polar (r, θ) back to rectangular (x, y). Both are on the CATALOG.

Example 31 Pol(— convert (3, 4) to polar

CATALOG Pol(3, 4 → EXE

```
Math DEG
Pol(3, 4)
r = 5, θ = 53.13°
```

The point (3, 4) has magnitude r = 5 and angle θ = 53.13° (Degree mode).

Example 32 Rec(— convert (2, 60°) to rectangular

CATALOG Rec(2, 60 → EXE

```
Math DEG
Rec(2, 60°)
x = 1, y = 1.732
```

The polar point r = 2, θ = 60° becomes (1, 1.732).

Variables & Independent Memory (M)

The calculator has ten memories — **A B C D E F x y z** and the independent memory **M** — that each hold one number. Press VARIABLE to open the menu, highlight a memory with ▲ ▼ and press OK; a small action menu then appears offering **Recall** or **Store** (M additionally offers **M+** and **M–**).

```
VARIABLE
A
B
C
D
E
F
x
y
z
M
```

```
A
Recall
Store
```

- **Store** evaluates whatever is on the current line — or reuses **Ans** if the line is empty — and saves the value into the chosen memory, replacing what was there.
- **Recall** inserts the memory's stored value into the calculation you are editing. Recalling straight after a result begins a fresh line.
- **M+ / M–** add or subtract the current value to/from **M** without overwriting it — ideal for accumulating a running total.

Clear all ten memories at once with ⚙ – [Reset] > [Variable Memory].

To store a value into a memory (for example, save 5 into A):

1. Type the value — **5** — on the line. *(Leave the line empty to store the last answer, **Ans**, instead.)*
2. Press VARIABLE to open the memory list.
3. Highlight the memory (**A**) with ▲ ▼ and press OK.
4. Choose **Store**. The value is now held in A until you overwrite it or reset the memory.

To recall a stored value: press VARIABLE, highlight the memory, press OK, then choose **Recall** — the stored value drops straight into whatever you are calculating.

Example 33 Store 5 into the variable A

5 VARIABLE A Store

```
Math DEG
5
      5
```

The value 5 is now held in A; the display confirms 5. It stays stored until you overwrite it or reset the memory.

Example 34 Recall A and calculate A × 3

VARIABLE A Recall × 3 EXE

```
Math DEG
A × 3
     15
```

Recalling A (= 5) gives 5 × 3 = 15.

Example 35 Running total with M+ : 3 × 4 then 5 × 6

3 × 4 VARIABLE M M+ 5 × 6 VARIABLE M M+

```
Math DEG
5 × 6
M = 42
```

Each M+ adds the line's value to M — first 12, then +30. Recall M (VARIABLE ▸ M ▸ Recall) to read the total 42.

> **Note**
>
> M+ / M– act on the current line's value. To add a value into M without displaying it first, type the value then choose VARIABLE ▸ M ▸ M+.

Ans, π, e & Constants

Ans reuses the previous answer; SHIFT 7 / 8 insert π and e. Physical constants come from CATALOG → CONST ▸.

Example 36 To calculate π × 2

SHIFT 7 × 2 EXE

```
Math DEG
π × 2
6.2831853072
```

π × 2 ≈ 6.2832. Press ⇄ to keep the exact form 2π.

Standard Form ($a \times 10^n$)

Press ×10ˣ to type a power-of-ten exponent directly — the natural way to enter very large or very small numbers. To have *results* shown in standard form, set ⚙ – [Calc Settings] > [Number Format] > [Sci].

Example 37 To enter 1.5×10^4

1 . 5 ×10ˣ 4 EXE

```
Math DEG
1.5 × 10⁴
15,000
```

The ×10ˣ key enters the “× 10 to the power” part in a single keystroke: $1.5 \times 10^4 = 15000$.

Result Formats & Tools

After a result, ⇄ (FORMAT / S⇔D) toggles exact ⇄ decimal, and the TOOLS menu offers Prime Factor, Recurring Decimal, Sexagesimal and Improper Fraction. The CATALOG adds ENG (engineering form) and FACT.

Example 38 S⇔D — toggle √8 between exact and decimal

√8) EXE ⇄

```
Math DEG
√8
2√2 ⇄ 2.8284271248
```

The exact form 2√2 and the decimal 2.8284… are the same value shown two ways.

Example 39 FACT — prime-factorise 360

3 6 0 EXE CATALOG FACT

```
Math DEG
360
2³ × 3² × 5
```

FACT breaks a whole number into its prime factors.

Example 40 ENG — engineering notation for 12345

12345 EXE CATALOG ENG

```
Math DEG
12345
12.345 × 10³
```

ENG shifts the exponent to a multiple of 3, ready for SI prefixes.

Statistics App Reference

Statistics

1-variable & 2-variable analysis

The **Statistics** app summarises a set of data and fits regression models. You type values into a list, then read off statistics such as the mean, standard deviation and quartiles; for paired data it also finds the line or curve of best fit. Open it from HOME by pointing to **Statistics** and pressing **OK**.

Choosing an analysis type

```
Select Calculation
1 1-Variable
2 y = a + bx
3 y = a + bx + cx²
4 y = a + b·ln(x)
5 y = a·e^(bx)
```

Choose **1-Variable** for a single list of numbers, or one of the **2-Variable** regression models for paired (x, y) data. The list continues with $\mathbf{y = a \cdot b^x}$, $\mathbf{y = a \cdot x^b}$ and **y = a + b/x**. Changing the type later clears the data.

Entering data

Type a value and press **EXE** to drop to the next row. Move with the arrow keys, overwrite a cell by typing over it, and delete a value with **DEL**. To weight values by how often they occur, turn on the **Frequency** column from ⚙ → **Statistics** ▸ **Frequency** ▸ **On**.

1-Variable statistics

Example 1 To summarise the data 2, 5, 6, 8, 9

Statistics ▸ **1-Variable** → enter data → **FUNCTION**

```
1-VARIABLE RESULT
x̄                 6
Σx               30
Σx²             210
σx     2.4494897428
sx     2.7386127875
```

The mean is $\bar{x} = \Sigma x / n = 30 / 5 =$ **6**. Two standard deviations are reported: $\boldsymbol{\sigma_x}$ (population, ÷ n) and $\mathbf{s_x}$ (sample, ÷ n – 1).

Enter the data with:

2 › **EXE** › **5** › **EXE** › **6** › **EXE** › **8** › **EXE** › **9** › **EXE** › **FUNCTION**

Example 2 To read the order statistics (same data)

scroll the result with ▼

1-VARIABLE RESULT (2/2)	
minX	2
Q_1	3.5
Median	6
Q_3	8.5
maxX	9

Scrolling down shows the five-number summary: minimum 2, first quartile 3.5, median 6, third quartile 8.5 and maximum 9.

Note

σ (divide by n) treats the data as the whole population; s (divide by n – 1) treats it as a sample estimating a larger population. Both are always shown.

Example 3 To weight values with a frequency column

⚙ Frequency ▸ On → enter x and Freq

1-Variable

x	Freq
10	2
20	5
30	3

Here the value 10 occurs twice, 20 five times and 30 three times (n = 10 in total), giving $\bar{x}$ = **21**, σ_x = **7** and s_x = **7.3786…**.

Normal distribution from 1-variable data

On the 1-variable result screen, press **EXE** to open the **Norm-Dist** tools. They convert a data value x to a probability using the fitted mean and σ: **P(t)** is the lower-tail area Φ(t), **Q(t)** = Φ(t) – 0.5, **R(t)** = 1 – Φ(t), and **▸t** standardises x into $t = (x - \bar{x}) / \sigma_x$.

Example 4 To standardise x = 8 and read its probability

1-Variable Result → **EXE** → ▸t / P(

NORM-DIST	
▸t (x=8)	0.8164965809
P(t)	0.792891967
Q(t)	0.292891967
R(t)	0.207108033

The value 8 standardises to t = (8 – 6) / 2.449 = 0.8165, and about **79.3%** of a normal population lies below it (P(t)).

Two-variable regression

Choose a 2-variable model to get an **x** and a **y** column. Enter each pair, then press **FUNCTION** for the fitted coefficients and the correlation r.

Example 5 To fit a line to (1,3) (2,5) (3,7) (4,8) (5,11)

Statistics ▸ y = a + bx → enter pairs → FUNCTION

```
REGRESSION RESULT
a                1.1
b                1.9
r       0.9904434668
x̄                  3
ȳ                6.8
```

The line of best fit is **y = 1.1 + 1.9x** and the correlation **r = 0.990** shows a strong positive relationship.

Example 6 To estimate ŷ and x̂ from the fitted line

VARIABLE ▸ ŷ / x̂

```
ESTIMATED VALUES
ŷ (x = 6)            12.5
x̂ (y = 9)    4.1578947368
```

Type a value then the estimate function: ŷ predicts y on the line at x = 6 (12.5); x̂ solves the line for x when y = 9.

Example 7 To fit an exponential model y = a·e^(bx)

Statistics ▸ y = a·e^(bx) → (1,2)(2,4)(3,8)(4,16) → FUNCTION

```
EXP REGRESSION
a                  1
b       0.6931471806
r                  1
```

The data doubles each step, so the fit is y = 1·e^(0.6931x) — and e^0.6931 = 2 exactly. Non-linear models drop any point that transforms to an undefined value.

Example 8 To fit a quadratic y = a + bx + cx² to (1,1) (2,4) (3,9) (4,16) (5,25)

Statistics ▸ y = a + bx + cx² → enter pairs → FUNCTION

```
QUADRATIC REGRESSION
a    0
b    0
c    1
```

The points lie exactly on $y = x^2$, so the fit returns a = 0, b = 0, c = **1**. The quadratic model reports the three coefficients a, b, c (it does not report a correlation r).

Example 9 To fit a power model $y = a \cdot x^b$ to (1,2) (2,8) (3,18) (4,32)

Statistics ▸ $y = a \cdot x^b$ → enter pairs → FUNCTION

```
POWER REGRESSION
a                              2
b                              2
r                              1
```

These points are exactly $y = 2x^2$, so the power fit recovers a = **2**, b = **2** with a perfect correlation r = 1. The power, ab-exponential and inverse models are fitted the same way — pick the shape that matches your data.

Menu item	Model	Reports r?
$y = a + bx$	Linear	Yes
$y = a + bx + cx^2$	Quadratic	No (a, b, c)
$y = a + b \cdot \ln(x)$	Logarithmic	Yes
$y = a \cdot e^{bx}$	e Exponential	Yes
$y = a \cdot b^x$	ab Exponential	Yes
$y = a \cdot x^b$	Power	Yes
$y = a + b/x$	Inverse	Yes

Editing and extending the data list

You can revise the data at any time without leaving the app. Move the cursor with the arrow keys and:

- **Correct a value** — point to the cell, type the new value and press EXE; it replaces the old one.
- **Clear a cell** — empty it with DEL. A blank row is simply skipped when the statistics are calculated, so you don't have to shuffle the rows below.
- **Add more data** — scroll to the first empty row at the bottom of the list and keep typing.

Press FUNCTION again after any change and every statistic is recomputed from the current list.

Example 10 To correct a mistyped value (the 6 was entered as 60)

point to the wrong cell → 6 EXE → FUNCTION

```
1-Variable
             x
                               2
                               5
                               6
                               8
                               9
```

Overwriting cell x_3 with 6 and pressing FUNCTION refreshes the whole result — no need to re-enter the other four values.

Statistics calculation screen

Example 11 To combine statistics in an expression ($\bar{x} \times 2 + \Sigma x$)

TOOLS ▸ Stat-Calc → VARIABLE inserts $\bar{x}$, Σx …

```
Stat DEG
x̄ × 2 + Σx
        42
```

Press **TOOLS** on a result screen for a free-form editor. Using the 1-variable data ($\bar{x} = 6$, $\Sigma x = 30$): $\bar{x} \times 2 + \Sigma x = 12 + 30 =$ **42**. Any statistic can be reused this way.

Distribution App Reference

Distribution

Normal, Binomial & Poisson

The **Distribution** app evaluates the common probability distributions. Choose a distribution from the menu, enter its parameters, and read the probability — or, for the list distributions, a whole table of probabilities.

Choosing a distribution

```
Distribution
1 Normal PD
2 Normal CD
3 Inverse Normal
4 Binomial PD
5 Binomial CD
```

PD gives the density / mass at a point; **CD** gives the cumulative probability up to a bound. The list also has **Poisson PD** and **Poisson CD**.

Normal distribution

Example 1 **Normal PD — density f(x) at x = 0.5, μ = 0, σ = 1**

Distribution ▸ Normal PD → x, μ, σ → EXE

```
NORMAL PD
x                 0.5
μ                   0
σ                   1
f(x)     0.3520653268
```

f(x) is the height of the bell curve, not a probability. For the standard normal the height at x = 0.5 is **0.3521**.

Example 2 **Normal CD — P(–1 ≤ X ≤ 1) for μ = 0, σ = 1**

Distribution ▸ Normal CD → Lower, Upper, μ, σ → EXE

```
NORMAL CD
Lower              -1
Upper               1
P        0.6826894723
```

The area between the bounds is the probability. This is the classic “68% within one σ”.

Example 3 Normal CD — heights ~N(170, 6), P(160 ≤ X ≤ 180)

Normal CD → 160, 180, 170, 6 → EXE

NORMAL CD	
Lower	160
Upper	180
μ	170
σ	6
P	0.9044193359

About **90.4%** of this population lies between 160 and 180 cm. For a one-sided probability use a very large or very small bound (e.g. Lower = -1×10^{99}).

Example 4 Inverse Normal — the value with 97.5% below it

Distribution ▸ Inverse Normal → Area, μ, σ → EXE

INVERSE NORMAL	
Area	0.975
μ	0
σ	1
xInv	1.9599639861

Inverse Normal reverses the question. The value with 97.5% of the standard-normal area below it is **1.96** — the familiar 95%-confidence cut-off.

Binomial distribution (list input)

Enter **N** (trials) and **p** (success probability) once, then a growable list of x values; a probability is returned for each. **PD** gives P(X = x); **CD** gives P(X ≤ x).

Example 5 Binomial PD — N = 10, p = 0.5, for x = 0…4

Distribution ▸ Binomial PD → N=10, p=0.5, x-list → EXE

Binomial PD

x	P
0	0.0009765625
1	0.009765625
2	0.0439453125
3	0.1171875
4	0.205078125

Ten fair coin tosses: the probability of exactly 3 heads is **0.1172**. Add as many x values as you like to build the whole table.

Example 6 Binomial CD — P(X ≤ 3), N = 10, p = 0.5

Binomial CD → N=10, p=0.5, x=3 → EXE

Binomial CD

x	P
3	0.171875

The cumulative form adds P(X = 0…3) = **0.171875** — the chance of at most 3 heads.

Poisson distribution (list input)

Example 7 Poisson PD — λ = 3, for x = 0…4

Distribution ▸ Poisson PD → λ=3, x-list → EXE

Poisson PD

x	P
0	0.0497870684
1	0.1493612051
2	0.2240418077
3	0.2240418077
4	0.1680313557

Events at an average rate λ = 3. The most likely counts are 2 and 3, each with probability **0.2240**.

Example 8 Poisson CD — P(X ≤ 2), λ = 3

Poisson CD → λ=3, x=2 → EXE

Poisson CD

x	P
2	0.4231900811

Adding P(X = 0, 1, 2) gives **0.4232** — the chance of two or fewer events.

Important!

List distributions accept several x values at once — add rows to the x list and every row is evaluated, giving a probability table you can scroll.

Table App Reference

Table

Function value tables

The **Table** app tabulates one or two functions over a range of x — ideal for plotting points, spotting where a function crosses zero, and comparing two functions side by side.

Defining the function(s) and range

Type the formula for **f(x)** using the x key for the variable. To tabulate a second function, turn on **g(x)** from ⚙ → **Table** ▸ **f(x)/g(x)**. The calculator then asks for **Start**, **End** and **Step** and builds a row for each x (up to 45 rows).

Example 1 To tabulate $f(x) = x^2 - 3$ for x = 1 … 5

Table → $f(x) = x^2 - 3$ → Start 1, End 5, Step 1 → EXE

Table

x	f(x)
1	−2
2	1
3	6
4	13
5	22

Between x = 1 and x = 2 the value changes sign (−2 → 1), so the graph crosses zero there — a quick way to locate a root. Scroll with ▲ ▼.

Enter the function with:

x › x² › – › 3 › EXE › 1 › EXE › 5 › EXE › 1 › EXE

Example 2 To tabulate $f(x) = x^2 - 3$ and $g(x) = 2x + 1$ together

⚙ f(x)/g(x) ▸ On → $g(x) = 2x + 1$ → x = 1 … 4

Table

x	f(x)	g(x)
1	−2	3
2	1	5
3	6	7
4	13	9

The two columns are closest near x = 3 (6 vs 7), showing roughly where the curves $x^2 - 3$ and $2x + 1$ intersect.

> **Note**
> The table holds up to 45 rows. If Start, End and Step would produce more, the list is truncated to fit. Edit the function or range from the ⚙ menu and the table regenerates.

Registering & using f(x) and g(x)

Defining a function in the Table app also **registers** it. Once **f(x)** (and optionally **g(x)**) is entered, you can call it by name in the **Calculate** app: insert **f(☐)** or **g(☐)** from the CATALOG and type a value for x in the box. This lets you reuse a formula without retyping it.

Example 3 Evaluate a registered function — f(3), where f(x) = 2x + 1

Calculate CATALOG f(☐) 3) EXE

```
Math DEG
f(3)
       7
```

With f(x) = 2x + 1 registered in the Table app, f(3) = 2·3 + 1 = 7.

Example 4 Composite function — g(f(2)), where f(x) = 2x + 1 and g(x) = x^2

Calculate CATALOG g(☐) → f(☐) 2 →)) EXE

```
Math DEG
g(f(2))
      25
```

The inner call gives f(2) = 5, then g(5) = 5^2 = 25. You can also make a function *itself* composite — define **g(x) = f(x)²** — and the calculator resolves the nested call (a built-in guard stops any accidental circular reference).

> **Note**
>
> **Data retention:** f(x) and g(x) stay registered when you switch between apps, so define them once in Table and use them in Calculate. Registering new functions replaces them; ⚙ – [Reset] > [Variable Memory] clears them.

Equation App Reference

Equation

Simultaneous systems & polynomials

The **Equation** app solves two kinds of problem: **simultaneous linear systems** with 2, 3 or 4 unknowns, and **polynomial equations** of degree 2, 3 or 4. You enter only the coefficients and the calculator returns the complete solution set.

Choosing an equation type

```
Equation Type
1 Simultaneous · 2 unknowns
2 Simultaneous · 3 unknowns
3 Simultaneous · 4 unknowns
4 Polynomial · ax²+bx+c
5 Polynomial · ax³+…
```

The list ends with **Polynomial · $ax^4+bx^3+cx^2+dx+e$**. Point to a type and press OK; the calculator lays out exactly the coefficient boxes that type needs.

Simultaneous equations

Each row of the grid is one equation. For 2 unknowns the columns are **x**, **y** and the constant **=**. Enter the coefficients left to right, pressing EXE after each.

Example 1 To solve 2x + 3y = 8 and x – y = –1

Equation ▸ Simultaneous · 2 unknowns → coefficients → EXE

```
SOLUTION
x        1
y        2
```

Enter the two rows (2, 3, 8) and (1, –1, –1). The unique solution is **x = 1, y = 2**.

Key operation:

2 › EXE › 3 › EXE › 8 › EXE › 1 › EXE › (–) › 1 › EXE › (–) › 1 › EXE

Example 2 To solve a 3-unknown system

Equation ▸ Simultaneous · 3 unknowns → EXE

```
SOLUTION
x        1
y        2
z        3
```

For x + y + z = 6, x – y + 2z = 5 and 2x + y – z = 1 the solution is **x = 1, y = 2, z = 3**. A 4-unknown system adds a w column.

> **Note**
>
> If a system has no unique solution the calculator reports **Infinite Solutions** or **No Solution** instead of values.

Polynomial equations

Enter the coefficients from the highest power down. The quadratic $x^2 - 5x + 6 = 0$ uses a = 1, b = –5, c = 6.

Example 3 To solve the quadratic $x^2 - 5x + 6 = 0$

Equation ▸ Polynomial · ax^2+bx+c → 1, –5, 6 → EXE

```
ROOTS
x1    3
x2    2
```

The two roots are **x = 3** and **x = 2**. After solving a quadratic or cubic, the result screen also offers the minimum / maximum point (vertex) of the curve.

Example 4 To solve the cubic $x^3 - 6x^2 + 11x - 6 = 0$

Polynomial · $ax^3+\ldots$ → 1, –6, 11, –6 → EXE

```
CUBIC ROOTS
x1    3
x2    1
x3    2
```

Three real roots: **1, 2 and 3**.

Example 5 To solve the quartic $x^4 - 5x^2 + 4 = 0$

Polynomial · $ax^4+\ldots$ → 1, 0, –5, 0, 4 → EXE

```
QUARTIC ROOTS
x1    2
x2    1
x3   -1
x4   -2
```

Four real roots: **±1 and ±2**. Enter 0 for any missing power (here b and d are 0).

Complex roots

When a polynomial has non-real roots, the **Equation Complex Roots** setting decides whether they are shown. It is **Off** by default (only real roots appear). Turn it on from SETTINGS → **Equation Complex Roots ▸ On**.

Example 6 To show the complex roots of $x^2 + 2x + 5 = 0$

SETTINGS ▸ Equation Complex Roots ▸ On → solve

```
COMPLEX ROOTS
x1    -1 + 2i
x2    -1 - 2i
```

This equation has no real roots. With the setting on it returns the conjugate pair **–1 ± 2i**; with it off it reports **No Real Roots**.

Inequality App Reference

Inequality

Polynomial inequalities

The **Inequality** app solves a polynomial inequality and reports the solution as a set of intervals on the number line. It handles quadratic, cubic and quartic inequalities against 0.

Choosing degree and direction

```
Inequality Degree
1 Quadratic ax²+bx+c
2 Cubic ax³+bx²+cx+d
3 Quartic ax⁴+…+e
```

After the degree, choose the direction against zero — **> 0**, **< 0**, **≥ 0** or **≤ 0** — then enter the coefficients exactly as in the Equation app.

Example 1 To solve $x^2 - 5x + 6 > 0$

Inequality ▸ Quadratic ▸ > 0 → **1, –5, 6** → EXE

```
Ineq DEG
x² − 5x + 6 > 0
x < 2 or x > 3
```

The factors are $(x - 2)(x - 3)$, so the expression is positive **outside** the roots: $x < 2$ or $x > 3$.

Example 2 To solve $x^2 - 5x + 6 \le 0$

Quadratic ▸ ≤ 0 → **1, –5, 6** → EXE

```
Ineq DEG
x² − 5x + 6 ≤ 0
2 ≤ x ≤ 3
```

With ≤, the boundary roots are included, so the answer is the closed interval **$2 \le x \le 3$**. The app writes ≤ / ≥ for inclusive directions and < / > for strict ones.

Example 3 To solve $x^3 - x > 0$

Cubic ▸ > 0 → **1, 0, –1, 0** → EXE

```
Ineq DEG
x³ − x > 0
−1 < x < 0 or x > 1
```

The roots are –1, 0 and 1; testing each region gives two solution intervals, joined with “**or**”.

> **Note**
> If the inequality is true everywhere the app shows **All Real Numbers**; if it is never true it shows **No Solution**.

Complex App Reference

Complex

Arithmetic with complex numbers

The **Complex** app performs the four operations on two complex numbers $z_1 = a + bi$ and $z_2 = c + di$, and can show the result in rectangular (a + bi) or polar (r∠θ) form. The imaginary unit i satisfies $i^2 = -1$.

Selecting the operation

Operation
1 $z_1 + z_2$
2 $z_1 - z_2$
3 $z_1 \times z_2$
4 $z_1 \div z_2$

Pick the operation first, then enter the real and imaginary parts of each number into the coefficient grid. The examples below all use $z_1 = 3 + 2i$ and $z_2 = 1 + 4i$.

Example 1 To add (3 + 2i) + (1 + 4i)

Complex ▸ $z_1 + z_2$ → 3, 2, 1, 4 → EXE

RESULT
$z_1 + z_2$ 4 + 6i

Add the real parts and the imaginary parts separately: (3 + 1) + (2 + 4)i = 4 + 6i.

Example 2 To subtract (3 + 2i) – (1 + 4i)

$z_1 - z_2$ → EXE

RESULT
$z_1 - z_2$ 2 – 2i

Subtract componentwise: (3 – 1) + (2 – 4)i = 2 – 2i.

Example 3 To multiply (3 + 2i) × (1 + 4i)

$z_1 \times z_2$ → EXE

RESULT
$z_1 \times z_2$ –5 + 14i

Use the distributive law with $i^2 = -1$: (3·1 – 2·4) + (3·4 + 2·1)i = **–5 + 14i**. Enter it with 3 › EXE › 2 › EXE › 1 › EXE › 4 › EXE › FUNCTION

Example 4 To divide (3 + 2i) ÷ (1 + 4i)

$z_1 \div z_2$ → EXE

RESULT
$z_1 \div z_2$ 0.6470588235 – 0.5882352941i

Multiply top and bottom by the conjugate of the denominator (1 – 4i). The denominator becomes $1^2 + 4^2 = 17$, a real number.

Polar form and complex functions

Set **Complex Result ▸ r∠θ** in SETTINGS to read a result in polar form. The **FUNCTION** menu inside the app also offers **Abs** (modulus |z|), **arg** (argument), **Conjg** (conjugate $\bar{z}$), **ReP** (real part) and **ImP** (imaginary part).

Example 5 To read 1 + i in polar form

SETTINGS ▸ Complex Result ▸ r∠θ

```
POLAR (DEG)
1 + i                √2 ∠ 45°
|1 + i|          1.4142135624
arg(1 + i)                 45
```

1 + i has modulus $r = \sqrt{2} \approx 1.4142$ and argument $\theta = 45°$ (in Degree mode). Changing the Angle Unit changes how θ is reported.

Note

Conjg flips the sign of the imaginary part (a + bi → a – bi); ReP and ImP extract the real and imaginary components as ordinary numbers.

Base-N App Reference

Base-N

Binary, octal, decimal & hexadecimal

The **Base-N** app works with whole numbers in four bases — **DEC** (10), **HEX** (16), **OCT** (8) and **BIN** (2) — and includes the bitwise logic operators. All arithmetic is integer arithmetic on a 32-bit two's-complement value.

Switching base

The active base is shown at the top of the screen. Press the base soft keys **DEC**, **HEX**, **OCT**, **BIN** to re-display the current value in another base — the value never changes, only its notation.

Example 1 To view the number 250 in every base

Base-N → 250 → HEX / OCT / BIN

250 in every base

Base	Value
DEC	250
HEX	FA
OCT	372
BIN	11111010

Enter 250 in DEC, then tap each base key. The single quantity 250 is **FA** in hexadecimal, **372** in octal and **11111010** in binary.

Example 2 To convert hexadecimal FF to decimal

Base-N ▸ HEX → FF → DEC

```
Base HEX → DEC
FF
        255
```

Type FF while the base is HEX (digits A–F appear on the number keys), then switch to DEC to read **255**.

Bitwise logic operators

Press CATALOG in Base-N to insert a logic operator: **and**, **or**, **xor**, **xnor**, **not** and **Neg** (two's-complement negate). These operate on the binary bit patterns.

Example 3 1100 and 1010 (in binary)

BIN → 1100 and 1010 → EXE

```
Base BIN
1100 and 1010
         1000
```

and keeps bits that are set in BOTH operands: only the leading bit is set in both, so the result is 1000.

Example 4 1100 or 1010 (in binary)

BIN → 1100 **or** 1010 → **EXE**

```
Base BIN
1100 or 1010
        1110
```

or keeps bits set in EITHER operand, giving 1110.

Negative values

Decimal shows a signed value; the other bases show the 32-bit two's-complement bit pattern, so a negative number prints as its unsigned pattern.

Example 5 To view –5 in two's-complement form

Base-N → –5 → **HEX**/**BIN**

–5 in two's complement

Base	Value
DEC	–5
HEX	FFFFFFFB
BIN	…11111011

In DEC, –5 keeps its sign. In HEX it is **FFFFFFFB**, and in BIN the full 32-bit pattern ends in …11111011.

Important!

Base-N is integer-only: fractions, decimals and roots are not available, and a result outside the signed 32-bit range (–2 147 483 648 … 2 147 483 647) is a Math ERROR.

Matrix App Reference

Matrix

Matrix arithmetic up to 4×4

The **Matrix** app performs calculations with matrices of up to four rows and four columns (and rectangular m×n matrices). You store values in the matrix memories **MatA**, **MatB**, **MatC** and **MatD**, then build an expression from them. The result of every matrix calculation is retained in a special memory called **MatAns**, which you can feed straight into the next calculation.

Creating and entering a matrix

When you open an operation, the calculator first asks for the **dimensions** (rows × columns), then shows an empty grid. Fill it cell by cell, pressing EXE after each value to advance to the next cell. This grid holds MatA = $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$:

MatA 2×2

	c1	c2
r1	2	1
r2	1	1

Choose 2 rows and 2 columns, then key in the four values:
2 › EXE › 1 › EXE › 1 › EXE › 1 › EXE

Important!
A matrix memory keeps its contents until you overwrite it or clear the app, so you can reuse MatA in several calculations without re-entering it.

The examples below all use these four matrices:

MatA = $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ **MatB** = $\begin{bmatrix} 2 & 3 \\ 2 & 1 \end{bmatrix}$ **MatC** = $\begin{bmatrix} 1 & 0 & -1 \\ 0 & -1 & 1 \end{bmatrix}$ **MatD** = $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$

Addition and Subtraction

Example 1 To add two matrices (MatA + MatB)

Matrix ▸ MatA + MatB → enter MatA, MatB → EXE

MatAns=

$$\begin{bmatrix} 4 & 4 \\ 3 & 2 \end{bmatrix}$$

Corresponding entries are added: the (1,1) entries 2 + 2 = 4, the (1,2) entries 1 + 3 = 4, and so on, giving $\begin{bmatrix} 4 & 4 \\ 3 & 2 \end{bmatrix}$.

Example 2 To subtract two matrices (MatA – MatB)

Matrix ▸ **MatA – MatB** → enter MatA, MatB → **EXE**

MatAns=

$$\begin{bmatrix} 0 & -2 \\ -1 & 0 \end{bmatrix}$$

Subtraction is also entry by entry: 2 – 2 = 0, 1 – 3 = –2, and so on.

> **Note**
> The two matrices must have the same dimensions in order to be added or subtracted. An error occurs if you try to add or subtract matrices of different dimensions.

Multiplication

Example 3 To multiply two matrices (MatA × MatB)

Matrix ▸ **MatA × MatB** → enter MatA, MatB → **EXE**

MatAns=

$$\begin{bmatrix} 6 & 7 \\ 4 & 4 \end{bmatrix}$$

Each result entry is a **row × column** dot product. The (1,1) entry is (row 1 of MatA)·(column 1 of MatB) = 2·2 + 1·2 = 6; the (1,2) entry is 2·3 + 1·1 = 7.

Example 4 To multiply matrices of different sizes (MatA × MatC)

Matrix ▸ **MatA × MatB** → MatA (2×2), MatC (2×3) → **EXE**

MatAns=

$$\begin{bmatrix} 2 & -1 & -1 \\ 1 & -1 & 0 \end{bmatrix}$$

A 2×2 times a 2×3 gives a 2×3 result, because MatA has 2 columns and MatC has 2 rows.

> **Important!**
> Matrix multiplication is only possible when the number of columns of the left matrix equals the number of rows of the right matrix. Note that MatA × MatB and MatB × MatA are generally **not** the same.

Powers — Square and Cube

A square matrix can be raised to a power. **MatA²** means MatA × MatA, and **MatA³** means MatA × MatA × MatA.

Example 5 To square and cube MatA ($MatA^2$, $MatA^3$)

Matrix ▸ **MatA²** / **MatA³** → **EXE**

```
MatAns=
```
$$\begin{bmatrix} 5 & 3 \\ 3 & 2 \end{bmatrix}$$

$MatA^2 = \begin{bmatrix} 5 & 3 \\ 3 & 2 \end{bmatrix}$. Cubing goes one step further: $MatA^3 = MatA^2 \times MatA = \begin{bmatrix} 13 & 8 \\ 8 & 5 \end{bmatrix}$.

Inverse

The inverse $MatA^{-1}$ is the matrix that satisfies $MatA \times MatA^{-1} = I$ (the identity). It exists only for a square matrix whose determinant is non-zero.

$$\begin{bmatrix} a_{11} \end{bmatrix}^{-1} = \begin{bmatrix} \frac{1}{a_{11}} \end{bmatrix}$$

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^{-1} = \frac{\begin{bmatrix} a_{22} & -a_{12} \\ -a_{21} & a_{11} \end{bmatrix}}{a_{11}a_{22} - a_{12}a_{21}}$$

Example 6 To invert MatA ($MatA^{-1}$)

Matrix ▸ **MatA det / inv / trans** ▸ **Inverse Matrix** → **EXE**

```
MatAns=
```
$$\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$$

Because det(MatA) = 1, the inverse is $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$. You can check it: $MatA \times MatA^{-1}$ returns the identity matrix.

> **Note**
> - Only square matrices (same number of rows and columns) can be inverted. Trying to invert a matrix that is not square produces an error.
> - A matrix with a determinant of zero cannot be inverted — for example MatD above has det 0, so $MatD^{-1}$ is an error.
> - Calculation precision is affected for matrices whose determinant is near zero.

Determinant

The determinant is a single number describing a square matrix. For 1×1, 2×2 and 3×3 matrices it is computed as:

$$\det \begin{bmatrix} a_{11} \end{bmatrix} = a_{11}$$

$$\det \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = a_{11}a_{22} - a_{12}a_{21}$$

$$\det\begin{bmatrix} a_{11} \end{bmatrix} = a_{11}$$

$$\det\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = a_{11}a_{22} - a_{12}a_{21}$$

$$\det\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} = a_{11}a_{22}a_{33} + a_{12}a_{23}a_{31} + a_{13}a_{21}a_{32} - a_{13}a_{22}a_{31} - a_{12}a_{21}a_{33} - a_{11}a_{23}a_{32}$$

Example 7 To obtain the determinant of MatA (Det(MatA))

Matrix ▸ MatA det / inv / trans ▸ Determinant → EXE

```
MatAns=
        [1]
```

det(MatA) = $a_{11}a_{22} - a_{12}a_{21} = 2\cdot1 - 1\cdot1 =$ **1**. A determinant is a scalar, so the result is a single value.

> **Note**
> Determinants can be obtained only for square matrices. Trying to obtain a determinant for a non-square matrix produces an error. The determinant of MatD (above) is 0, which is why it has no inverse.

Transpose

The transpose M^T turns rows into columns. It works for any matrix, including rectangular ones.

Example 8 To transpose MatC (Trn(MatC))

Matrix ▸ MatA det / inv / trans ▸ Transpose → MatC → EXE

```
MatAns=
        [ 1   0 ]
        [ 0  -1 ]
        [-1   1 ]
```

The 2×3 matrix MatC becomes a 3×2 matrix — row 1 (1, 0, –1) becomes column 1, and row 2 (0, –1, 1) becomes column 2.

Identity Matrix

Identity(n) creates the n×n identity matrix — 1s on the main diagonal and 0s everywhere else. Multiplying any matrix by the identity leaves it unchanged.

Example 9 To create the 3×3 identity matrix (Identity(3))

Matrix ▸ **Identity(n)** → 3 → **EXE**

```
MatAns=
```

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Enter the size n = 3. Larger results that overflow the screen can be scrolled with the ▲ ▼ ◀ ▶ keys.

> **Note**
>
> The result of each matrix calculation is stored in MatAns. You can use MatAns in a following calculation — for example, invert a matrix and then multiply the original by MatAns to confirm you get the identity.

Vector App Reference

Vector

2D & 3D vector operations

The **Vector** app stores two vectors, **VctA** and **VctB**, in 2 or 3 dimensions and computes their sum, difference, dot product, cross product, magnitudes, the angle between them and their unit vectors.

Choosing dimensions

Vector Dimension
1 2D vectors (x, y)
2 3D vectors (x, y, z)

Pick 2D or 3D, then enter the components of VctA and VctB. The 2D cross product is a single scalar; the 3D cross product is another vector.

$$A \cdot B = AxBx + AyBy + AzBz \quad |A| = \sqrt{(Ax^2 + Ay^2 + Az^2)} \quad \cos\theta = \frac{A \cdot B}{|A|\,|B|}$$

Example 1 3D vectors VctA = (1, 2, 3), VctB = (4, 5, 6)

Vector › 3D vectors → enter A, B → FUNCTION

VECTOR RESULT (DEG)	
VctA · VctB	32
VctA × VctB	(−3, 6, −3)
|VctA|	3.7416573868
Angle	12.9331544919

The **dot product** is 1·4 + 2·5 + 3·6 = 32; the **cross product** (−3, 6, −3) is perpendicular to both; **|VctA|** = $\sqrt{14} \approx 3.742$; and the **angle** is about 12.93° (Degree mode).

Key operation:

1 › EXE › 2 › EXE › 3 › EXE › 4 › EXE › 5 › EXE › 6 › EXE › FUNCTION

Example 2 2D vectors VctA = (3, 4), VctB = (1, 0)

Vector › 2D vectors → enter A, B → FUNCTION

2D RESULT	
VctA · VctB	3
VctA × VctB	−4
|VctA|	5
Angle	53.1301023542

In 2D the cross product is a single scalar (−4). |VctA| = $\sqrt{(3^2 + 4^2)} = 5$, and the angle between the vectors is 53.13°.

Example 3 The unit vector Â of VctA = (3, 4)

FUNCTION ▸ Unit Vector Â

```
UNIT VECTOR
|VctA|                 5
Â (unit)      (0.6, 0.8)
```

The unit vector Â = A / |A| = (3/5, 4/5) = (0.6, 0.8) has length 1 and points the same way as A.

Note

The angle uses the current Angle Unit. In Radian mode the same vectors give the angle in radians instead of degrees.

Ratio App Reference

Ratio

Solving proportions

The **Ratio** app finds the missing term X in a proportion A : B = C : D. Choose which position is unknown, enter the three known values, and the calculator solves for X by cross-multiplication.

Choosing the form

```
Ratio Form
1 A : B = X : D
2 A : B = C : X
```

Form 1 solves for the third term; form 2 solves for the fourth. Both use the rule that equal ratios cross-multiply: A · D = B · C.

Example 1 To solve 3 : 4 = X : 8

Ratio › A : B = X : D → 3, 4, 8 → FUNCTION

```
A : B = X : D
A              3
B              4
D              8
X              6
```

X = (A · D) / B = (3 · 8) / 4 = **6**. This is just the proportion $3/4 = X/8$, so 4X = 24.

Key operation:

3 › EXE › 4 › EXE › 8 › EXE › FUNCTION

Example 2 To solve 3 : 4 = 6 : X

Ratio › A : B = C : X → 3, 4, 6 → FUNCTION

```
A : B = C : X
A              3
B              4
C              6
X              8
```

X = (B · C) / A = (4 · 6) / 3 = **8**.

> **Note**
>
> Two ratios are equal exactly when their cross-products match (A · D = B · C).

Spreadsheet App Reference

Spreadsheet

A calculator spreadsheet

The **Spreadsheet** app is a grid of **5 columns (A–E) × 45 rows**. Each cell holds either a number or a formula that begins with **=** and may reference other cells (A1, B2, …). Formulas recalculate automatically as you edit.

Entering constants

Move the cursor with the arrow keys and type a number to enter a constant into a cell. Press **EXE** to confirm and drop to the next row. The examples in this chapter build on column A holding the values 1 to 5.

Example 1 To enter the values 1–5 into cells A1 to A5

Spreadsheet → point to A1 → 1 EXE 2 EXE …

Spreadsheet

	A
1	1
2	2
3	3
4	4
5	5

Each value is typed and confirmed with **EXE**, which moves down to the next cell. The reference of a cell is its column letter and row number, so the value 3 sits in **A3**.

Entering formulas

Start a cell with **=** to make it a formula. A formula may contain numbers, operators and **cell references** (A1, B2, …). A reference always tracks the current value of that cell, so the formula recalculates automatically whenever the referenced cell changes.

Example 2 To put =A1×2 in cell B1

point to B1 → = A1 × 2 EXE

Spreadsheet

	A	B
1	1	2
2	2	
3	3	
4	4	
5	5	

B1 shows its computed value **2** (= 1 × 2). If you later change A1, B1 updates by itself. Use **Show Cell** (TOOLS) to view the underlying formula =A1×2 instead of the value.

Relative and absolute references

When a formula is copied or filled to another cell, its references shift with it — these are **relative** references. A **$** locks part of a reference so it does **not** shift: **A1** is fully locked, **A$1** locks only the row and **$A1** only the column.

Example 3 To fill =A1×2 down column B (relative reference)

B1 → TOOLS ▸ Fill Formula → range B1:B5 → EXE

Spreadsheet

	A	B
1	1	2
2	2	4
3	3	6
4	4	8
5	5	10

Filling adjusts the relative reference for each row: B2 becomes =A2×2, B3 becomes =A3×2, and so on — giving 2, 4, 6, 8, 10.

Example 4 To fill =A1×A5 down column C (absolute reference)

C1 → TOOLS ▸ Fill Formula → range C1:C5 → EXE

Spreadsheet

	A	C
1	1	5
2	2	10
3	3	15
4	4	20
5	5	25

The A5 part is locked to cell A5 (= 5) in every row, while A1 shifts to A2, A3, … So the column becomes A × 5 = 5, 10, 15, 20, 25.

Range commands — Sum, Min, Max, Mean

The commands **Sum(**, **Min(**, **Max(** and **Mean(** operate over a block of cells written as a range such as A1:A5. Insert them from the **SHEET** commands in the CATALOG.

Example 5 To total column A with =Sum(A1:A5)

CATALOG ▸ SHEET ▸ Sum(→ A1:A5 → EXE

Sheet
=Sum(A1:A5)
15

Sum adds every value in the range: 1 + 2 + 3 + 4 + 5 = **15**.

Example 6 To find the mean, maximum and minimum of A1:A5

CATALOG ▸ SHEET ▸ Mean(/ Max(/ Min(→ A1:A5 → EXE

RANGE COMMANDS	
=Mean(A1:A5)	3
=Max(A1:A5)	5
=Min(A1:A5)	1

Mean returns the average (15 ÷ 5 = 3), while Max and Min return the largest and smallest values in the range.

Batch input — Fill Value

To put the **same constant** into many cells at once, use **Fill Value** instead of typing it row by row.

Example 7 To write the constant 100 into D1:D3 with Fill Value

TOOLS ▸ Fill Value → Value 100, range D1:D3 → EXE

Spreadsheet

	D
1	100
2	100
3	100

Fill Value writes the constant into every cell of the range in one step. Its companion **Fill Formula** (Examples 3–4) does the same for a formula, adjusting the relative references as it goes.

The spreadsheet TOOLS menu

Press TOOLS inside the sheet for editing commands that act on the pointed cell or range:

Command	What it does
Fill Formula	Copies a formula across a range, adjusting relative references (locked $ parts stay put).
Fill Value	Writes the same constant into every cell of a range.
Copy & Paste	Duplicates a cell, adjusting its relative references at the destination.
Cut & Paste	Moves a cell; references are kept and the source is cleared.
Grab	Point to a cell to insert its reference into the formula you are editing.
Show Cell	Toggles the grid between showing computed **values** and the underlying **formulas**.
Auto Calc	Turns automatic recalculation on or off; Recalculate refreshes on demand.
Delete All	Clears the whole spreadsheet.

Important!

The spreadsheet holds up to 5 × 45 = 225 cells. Turning Auto Calc off freezes the displayed values — useful while entering a large sheet — until you Recalculate.

Math Box App Reference

Math Box

Learning-support tools

The **Math Box** app is a set of interactive learning aids: probability experiments and visual number tools. Choose a tool from the menu.

The Math Box menu

Math Box
1 Dice Roll
2 Coin Toss
3 Number Line
4 Circle

Each tool runs an experiment or draws a figure you can explore. Point to a tool and press **OK**.

Example 1 Dice Roll — 2 dice, 20 rolls

Math Box ▸ Dice Roll → dice 2, attempts 20 → **EXE**

Dice Roll

Sum	Freq
5	3
6	5
7	6
8	4

Rolls 1–3 dice for a chosen number of attempts and tallies each outcome — a hands-on way to see experimental probability approach the theoretical values. The **Same Result** setting (Off / #1 / #2 / #3) replays a fixed random sequence so a whole class sees identical rolls.

Example 2 Coin Toss — 2 coins, 20 tosses

Math Box ▸ Coin Toss → coins 2, attempts 20 → **EXE**

Coin Toss

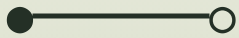
Heads	Freq
0	5
1	11
2	4

With two coins the middle outcome (one head, one tail) is about twice as likely as two heads or two tails — visible directly in the tally.

Example 3 Number Line — draw 2 ≤ x < 5

Math Box ▸ **Number Line** ▸ **a ≤ x < b** → 2, 5

```
Number Line
2 ≤ x < 5
```



```
[2, 5)
```

Draws the solution of a simple inequality: a filled circle for an inclusive bound, an open circle for a strict one. Nine expression types are available, from x < a to a ≤ x ≤ b.

Example 4 Circle — the Unit Circle at 30°

Math Box ▸ **Circle** ▸ **Unit Circle**

```
UNIT CIRCLE
Angle                    30°
cos θ (x)       0.8660254038
sin θ (y)                0.5
```

Displays a Unit Circle, Half Circle or Clock. At 30° the point is (cos 30°, sin 30°) = (√3⁄2, 1⁄2) ≈ (0.866, 0.5) — a visual link between angles and coordinates.

> **Note**
>
> Math Box tools are for exploration and teaching; they don't feed results into the other apps, but the frequency tables and coordinates can be read off directly.

Constants & Unit Conversions

Physical Constants

CATALOG → CONST ▸

The **CONST ▸** sub-menu inserts any of these 47 scientific constants (CODATA-based values) into a calculation. Point to a category, then to a constant, and press **OK** to insert its symbol and value. The six categories and their constants are:

Universal

Symbol	Constant	Value	Unit
h	Planck constant	$6.62607015 \times 10^{-34}$	J·s
ħ	reduced Planck constant (h/2π)	$1.054571817 \times 10^{-34}$	J·s
c	speed of light in vacuum	2.99792458×10^{8}	m/s
ε_0	electric constant	$8.8541878188 \times 10^{-12}$	F/m
μ_0	magnetic constant	$1.25663706127 \times 10^{-6}$	N/A^2
Z_0	vacuum impedance	376.730313412	Ω
G	gravitational constant	6.6743×10^{-11}	$m^3 \cdot kg^{-1} \cdot s^{-2}$
lP	Planck length	1.616255×10^{-35}	m
tP	Planck time	5.391247×10^{-44}	s

Electromagnetic

Symbol	Constant	Value	Unit
μN	nuclear magneton	$5.0507837393 \times 10^{-27}$	J/T
μB	Bohr magneton	$9.2740100657 \times 10^{-24}$	J/T
e	elementary charge	$1.602176634 \times 10^{-19}$	C
Φ_0	magnetic flux quantum	$2.067833848 \times 10^{-15}$	Wb
G_0	conductance quantum	$7.748091729 \times 10^{-5}$	S
KJ	Josephson constant	$4.835978484 \times 10^{14}$	Hz/V
RK	von Klitzing constant	25812.80745	Ω

Atomic & Nuclear

Symbol	Constant	Value	Unit
mp	proton mass	$1.67262192595 \times 10^{-27}$	kg
mn	neutron mass	$1.67492750056 \times 10^{-27}$	kg
me	electron mass	$9.1093837139 \times 10^{-31}$	kg
mμ	muon mass	$1.883531627 \times 10^{-28}$	kg

a_0	Bohr radius	$5.29177210544 \times 10^{-11}$	m
α	fine-structure constant	0.0072973525643	—
re	classical electron radius	$2.8179403205 \times 10^{-15}$	m
λC	Compton wavelength	$2.42631023538 \times 10^{-12}$	m
γp	proton gyromagnetic ratio	$2.6752218708 \times 10^{8}$	$s^{-1}·T^{-1}$
λCp	proton Compton wavelength	$1.3214098536 \times 10^{-15}$	m
λCn	neutron Compton wavelength	$1.31959090382 \times 10^{-15}$	m
R∞	Rydberg constant	$1.09737315682 \times 10^{7}$	m^{-1}
μp	proton magnetic moment	$1.41060679545 \times 10^{-26}$	J/T
μe	electron magnetic moment	$-9.2847646917 \times 10^{-24}$	J/T
μn	neutron magnetic moment	$-9.6623653 \times 10^{-27}$	J/T
μμ	muon magnetic moment	$-4.4904483 \times 10^{-26}$	J/T
mτ	tau mass	3.16754×10^{-27}	kg

Physico-Chem

Symbol	Constant	Value	Unit
mu	atomic mass constant	$1.66053906892 \times 10^{-27}$	kg
F	Faraday constant	96485.33212	C/mol
NA	Avogadro constant	$6.02214076 \times 10^{23}$	mol^{-1}
k	Boltzmann constant	1.380649×10^{-23}	J/K
Vm	molar volume of ideal gas	0.02271095464	m^3/mol
R	molar gas constant	8.314462618	$J·mol^{-1}·K^{-1}$
c_1	first radiation constant	$3.741771852 \times 10^{-16}$	$W·m^2$
c_2	second radiation constant	0.01438776877	m·K
σ	Stefan-Boltzmann constant	$5.670374419 \times 10^{-8}$	$W·m^{-2}·K^{-4}$

Adopted Values

Symbol	Constant	Value	Unit
gn	std acceleration of gravity	9.80665	m/s^2
atm	standard atmosphere	101325	Pa
RK-90	conventional von Klitzing	25812.807	Ω
KJ-90	conventional Josephson	4.835979×10^{14}	Hz/V

Other

Symbol	Constant	Value	Unit
t	Celsius temperature (0 °C)	273.15	K

Note
Values follow the 2022 CODATA recommended set. A constant is inserted as its stored value; combine it with other terms just like any number.

Unit Conversions

CATALOG → CONV ▸

The **CONV** ▸ sub-menu converts the value currently on the display. First compute or type a value, then choose a category and a conversion; the display is replaced by the converted value. There are 40 conversions in nine categories:

Length

Conversion	Factor
in ▶ cm	× 2.54
cm ▶ in	÷ 2.54
ft ▶ m	× 0.3048
m ▶ ft	÷ 0.3048
yd ▶ m	× 0.9144
m ▶ yd	÷ 0.9144
mile ▶ km	× 1.609344
km ▶ mile	÷ 1.609344
n mile ▶ m	× 1852
m ▶ n mile	÷ 1852
pc ▶ km	$\times 3.0856776 \times 10^{13}$
km ▶ pc	$\div 3.0856776 \times 10^{13}$

Area

Conversion	Factor
acre ▶ m^2	× 4046.856422
m^2 ▶ acre	÷ 4046.856422

Volume

Conversion	Factor
gal(US) ▶ L	× 3.785411784
L ▶ gal(US)	÷ 3.785411784

gal(UK) ▶ L	× 4.54609
L ▶ gal(UK)	÷ 4.54609

Mass

Conversion	Factor
oz ▶ g	× 28.349523125
g ▶ oz	÷ 28.349523125
lb ▶ kg	× 0.45359237
kg ▶ lb	÷ 0.45359237

Velocity

Conversion	Factor
km/h ▶ m/s	÷ 3.6
m/s ▶ km/h	× 3.6

Pressure

Conversion	Factor
atm ▶ Pa	× 101325
Pa ▶ atm	÷ 101325
mmHg ▶ Pa	× 133.322387415
Pa ▶ mmHg	÷ 133.322387415
kgf/cm² ▶ Pa	× 98066.5
Pa ▶ kgf/cm²	÷ 98066.5
lbf/in² ▶ kPa	× 6.894757293
kPa ▶ lbf/in²	÷ 6.894757293

Energy

Conversion	Factor
kgf·m ▶ J	× 9.80665
J ▶ kgf·m	÷ 9.80665
J ▶ cal_{15}	÷ 4.1858
cal_{15} **▶ J**	× 4.1858

Power

Conversion	Factor
hp ▶ kW	× 0.745699872
kW ▶ hp	÷ 0.745699872

Temperature

Conversion	Factor
°F ▶ °C	(x − 32) × 5⁄9
°C ▶ °F	x × 9⁄5 + 32

Note

Factors follow NIST Special Publication 811. Each conversion has a matching reverse conversion (for example in ▶ cm and cm ▶ in), so you can convert in either direction.

Technical Reference

Calculation Priority Sequence

Order of operations

The calculator evaluates an expression according to a fixed priority sequence. Basically, calculations run from left to right, expressions inside parentheses have the highest priority, and each command has the priority shown below.

Priority	Commands
1	Parenthetical expressions
2	Functions that take parentheses — sin(, cos(, tan(, ln(, log(, √, ∛, log□(, Abs(, GCD(, LCM(, d/dx, ∫dx, Σ, Π, Pol(, Rec(and similar
3	Functions that come after a value — x^2, x^3, x^{-1}, x!, %, angle units $^{\circ}$ ^{r} ^{g} — and powers ($x^{\square}$) and roots ($\sqrt[\square]{\square}$)
4	Negative sign (–) and Base-N prefixes (d, h, b, o)
5	Permutation (nPr), combination (nCr), complex polar symbol (∠)
6	Implicit multiplication — an omitted × before a value, constant or bracket (2π, 3(1+2))
7	Multiplication (×), division (÷), dot product (·)
8	Addition (+), subtraction (–)
9	and (logical operator, Base-N)
10	or, xor, xnor (logical operators, Base-N)

Important!

Implicit multiplication (priority 6) binds **tighter** than explicit × and ÷ (priority 7). This is why **6 ÷ 2(1 + 2) = 1** — the calculator reads it as 6 ÷ (2 × (1 + 2)) — and **6 ÷ 2π = 0.9549…** reads as 6 ÷ (2π).

Precautions when a calculation contains negative values

Because a postfix function such as x^2 (priority 3) binds tighter than the negative sign (priority 4), a leading minus applies to the whole power. To square a negative value you must enclose it in parentheses.

-2^2 = -4

```
Math DEG
−2²
                    −4
```

reads $-(2^2)$: the square is taken first, then negated

$(-2)^2$ = 4

```
Math DEG
(−2)²
                     4
```

the parentheses square the whole value −2

Calculation Ranges, Digits and Precision

How the emulator computes

The SC-991BF emulator performs every calculation in **IEEE-754 double precision** — the same arithmetic used throughout modern computing — and then formats the answer the way a scientific calculator would.

Property	Value
Internal precision	Double precision — about 15–16 significant digits
Displayed digits (Norm)	Up to 10 significant digits
Switch to scientific form	When $|x| \geq 1\times10^{10}$ or $|x| < 1\times10^{-9}$ (Norm 2, default); $< 1\times10^{-2}$ in Norm 1
Fix setting	Fixed number of decimal places, 0 to 9
Sci setting	Fixed number of significant figures

Note

Errors are cumulative across consecutive calculations, and tend to be larger near a function's singular points and inflection points. Functions that need repeated internal calculation — x^y, $\sqrt[x]{y}$, x!, nPr, nCr, numerical d/dx and ∫dx — can accumulate error with each step.

Function input ranges

The following table lists the practical input range of the main functions. Values outside a range give a **Math ERROR**.

Function	Input range
sin x, cos x, tan x	Degree: $|x| < 9\times10^{9}$ · Radian: $|x| < 157079632.7$ · (tan x undefined at odd multiples of 90°)
$\sin^{-1}x$, $\cos^{-1}x$	$0 \leq |x| \leq 1$
$\tan^{-1}x$	$|x| \leq 9.999999999\times10^{99}$
sinh x, cosh x	$|x| \leq 230.2585092$
$\sinh^{-1}x$	$|x| \leq 4.999999999\times10^{99}$
$\cosh^{-1}x$	$1 \leq x \leq 4.999999999\times10^{99}$
tanh x	$|x| \leq 9.999999999\times10^{99}$
$\tanh^{-1}x$	$|x| \leq 9.999999999\times10^{-1}$
log x, ln x	$0 < x \leq 9.999999999\times10^{99}$
10^x	$-9.999999999\times10^{99} \leq x \leq 99.99999999$
e^x	$-9.999999999\times10^{99} \leq x \leq 230.2585092$
$\sqrt{x}$	$0 \leq x < 1\times10^{100}$
x^2	$|x| < 1\times10^{50}$
x^{-1}	$|x| < 1\times10^{100}$; $x \neq 0$
x!	$0 \leq x \leq 69$ (x is an integer)
nPr, nCr	$0 \leq r \leq n$; $n < 1\times10^{10}$ (n, r integers)
Pol(x, y)	$|x|, |y| \leq 9.999999999\times10^{99}$
Rec(r, θ)	$0 \leq r \leq 9.999999999\times10^{99}$; θ same as sin x
RanInt#(a, b)	$a < b$; $|a|, |b| < 1\times10^{10}$

GCD(a, b), LCM(a, b)	integers, |a|, |b| < 1×10^{10}

Note

The Base-N app works only with integers in the signed 32-bit range –2 147 483 648 to 2 147 483 647; a result outside this range is a Math ERROR.

Error Messages

Causes and remedies

When a calculation cannot be completed, the calculator shows an error message instead of a result. Press ◀ or ▶ to return to the expression with the cursor at the position of the problem, correct it, and try again. The common messages are:

Message	Cause	Remedy
Syntax ERROR	The expression is not written correctly — for example mismatched parentheses, or an operator with a missing operand.	Check the input at the cursor and correct the format.
Math ERROR	The calculation is mathematically undefined or out of range — division by zero, √ of a negative in real mode, or a value outside a function's input range (see the table above).	Check the values. For a square root or power that gives a complex result, use the **Complex** app.
Dimension ERROR	A matrix or vector operation was attempted on incompatible sizes — for example adding matrices of different dimensions, or multiplying when the columns of the first do not equal the rows of the second.	Re-enter the matrices or vectors with compatible dimensions.
Square only	A determinant or inverse was requested for a matrix that is not square.	Use a square matrix (equal rows and columns).
Cannot Solve	SOLVE could not find a root of the equation starting from the current value of x.	Store a different starting value in x, closer to the expected root, and solve again.

Note

Some apps also show short guidance messages such as **No data**, **No equation**, **f(x) empty** or **Empty**. These are not errors — they simply mean the app needs you to enter its data or expression before it can calculate.

Specifications

Emulator & platforms

Product	eBidyaloy SC-991BF — scientific calculator emulator
Platforms	Windows, macOS, Web, Android and iOS
Calculator apps	13 (Calculate, Statistics, Distribution, Table, Equation, Inequality, Complex, Matrix, Vector, Spreadsheet, Ratio, Math Box, Base-N)
Display	Natural textbook display (MathI/MathO) with an optional enlarged “extended display” for classrooms
Variable memories	A, B, C, D, E, F, x, y, z, M, plus Ans and MatAns
Matrix memories	MatA, MatB, MatC, MatD (up to 4×4)

Physical constants	47 constants in 6 categories (CODATA-based)
Unit conversions	40 conversions in 9 categories
Internal precision	IEEE-754 double precision (~15 significant digits)
Power	None required — the emulator is software and is always ready to use on the host device

Note
Because the SC-991BF is a software emulator, there is no battery to replace and no low-battery warning: it is available whenever the app or web page is open, and its speed depends on the host device.

Frequently Asked Questions

Frequently Asked Questions

Q How can I change a fraction result to decimal form?

A While a fraction result is on screen, press ⇄ (FORMAT / S⇔D) to toggle between the exact form (fraction, π, √) and a decimal. To make results appear as decimals from the start, change **Input/Output** in SETTINGS to **MathI/DecimalO**.

Q What is the difference between Ans memory and variable memory?

A Both store a single value. **Ans** holds the result of the last calculation, letting you carry it straight into the next one (press Ans). A **variable** (A–F, x, y, z, M) is a named container you fill yourself and reuse whenever you need the same value more than once.

Q How can I find a function from an older calculator model?

A Almost every function lives on the **CATALOG**. Press CATALOG to open the catalog menu, then pick the function or constant you need. See **Using the CATALOG** earlier in this guide for the full list.

Q How do I change the calculation result display format?

A Press ⇄ (FORMAT) after a result to cycle exact ⇄ decimal, or open the TOOLS menu for Prime Factor, Recurring Decimal, Sexagesimal and Improper/Mixed Fraction. Result defaults are set in SETTINGS (Number Format, Fraction Result, Complex Result).

Q How can I tell which calculator app I am currently using?

A Press ⌂ (HOME). The icon of the app you are in is highlighted on the HOME screen.

Q How do I calculate $\sin^2 x$?

A $\sin^2 x$ means $(\sin x)^2$. Enter it as the square of the sine — for example $\sin^2 30° = (\sin 30°)^2 = ¼$:

(› sin › 3 › 0 ›) › □² › EXE

Q Why can't I input i or calculate with complex numbers in Calculate?

A The **Calculate** app works with real numbers. To enter the imaginary unit i or perform complex arithmetic, switch to the **Complex** app.

Q How can I return the calculator to its initial default settings?

A Open any app from HOME, then press ⚙ (SETTINGS) and choose **Reset** ▸ **Settings & Data** ▸ **Yes**. This restores the default settings and clears memories.

Q Do I need to worry about the battery?

A No. The SC-991BF is a software emulator, so it has no battery, never shows a low-battery warning, and is ready whenever you open it.