Finance formula sheet

Interest, borrowing and growth

Constant-rate educational models. No fees, taxes, inflation adjustment or irregular cash flows are included. A nominal interest rate is not necessarily a legally disclosed APR.

Compound growth

$$A = P\left(1 + \frac{r}{m}\right)^{mt}$$

P is the initial balance; r is the annual nominal rate as a decimal; m is compounding periods per year; t is years. No later deposits or withdrawals.

Simple interest

$$I = Prt, \qquad A = P + I$$

I is interest on the unchanged principal P. Use an annual decimal rate r and years t; this model does not compound interest.

Effective annual yield

$$y = \left(1 + \frac{r}{m}\right)^{m} - 1$$

Use annual nominal decimal rate r and m compounding periods per year. y is the decimal annual yield; interest stays in the account.

Level loan payment

$$M = \frac{Pi}{1 - (1+i)^{-N}}$$

P is principal; M is each payment. Use rate $i > 0$ per payment period and $N \geq 1$ end-of-period payments. For $i = 0$, use $M = P/N$.

Present value

$$PV = \frac{F}{(1+i)^{N}}$$

F is one future amount after N periods; $i > -1$ is the discount rate per period. This does not value a series of separate cash flows.

Compound annual growth

$$g = \left(\frac{V_f}{V_0}\right)^{1/t} - 1$$

$V_0 > 0$ and $V_f > 0$ are beginning and ending values; $t > 0$ is years. g is a decimal rate. Intermediate cash flows are excluded.

Worked example / Two years of monthly compounding

Start with $P = 1000$ currency units at a nominal annual rate of 5%, compounded monthly for two years. There are no additional cash flows.

1. Write the annual rate as a decimal and count the compounding periods.

$$r = 0.05, \quad m = 12, \quad mt = 24$$

2. Substitute without rounding the periodic rate.

$$A = 1000\left(1 + \frac{0.05}{12}\right)^{24}$$

3. Round the final balance to two decimal places.

$$A \approx 1104.94, \qquad I \approx 104.94$$

The unrounded balance is used to find interest. Monthly deposits would require a different model; use the linked calculator for that scenario.

Source checks & next step

OpenStax: simple interest / OpenStax: compound interest and present value / OpenStax: loan payments

Check a savings scenario / Full previews and sources: toolarithm.com/resources/formula-sheets

Math formula sheet

Percentages, coordinates, geometry and spread

A compact selection, not a complete course formula list. The meaning of a symbol is local to its card. Use consistent length units before calculating areas or distances.

Percentage of a whole

$$a = \frac{p}{100}W$$

p is the percentage coefficient, W is the whole and a is the part. For 25%, enter $p = 25$, not 0.25.

Relative percent change

$$\Delta p = \frac{V_1 - V_0}{V_0} \times 100\%$$

Use the starting value $V_0 > 0$ as the baseline. V_1 is the final value. A zero baseline is undefined; percentage points are a different comparison.

Slope through two points

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

The points are (x_1, y_1) and (x_2, y_2). Require $x_2 \neq x_1$; a vertical line has undefined slope. Keep subtraction order consistent.

Area of a circle

$$A = \pi r^2$$

r is the radius, not the diameter. A uses square units. With diameter d, first use $r = d/2$. Retain π until the final rounding.

Pythagorean theorem

$$a^2 + b^2 = c^2$$

For a right triangle, a and b are its legs and c is the hypotenuse opposite the right angle. This relationship does not apply to every triangle.

Sample standard deviation

$$s = \sqrt{\frac{\sum_{j=1}^{n}(x_j - \bar{x})^2}{n - 1}}$$

x_j are observations, $\bar{x}$ is their mean and $n \geq 2$ is the count. For the entire population, use denominator n and population mean instead.

Worked example / Find a slope and check its sign

Find the slope through $(2, 3)$ and $(8, 15)$. Use the same point order for the horizontal and vertical changes.

1. Subtract the first coordinates from the second coordinates.

$$\Delta x = 8 - 2 = 6, \quad \Delta y = 15 - 3 = 12$$

2. Divide the vertical change by the nonzero horizontal change.

$$m = \frac{12}{6} = 2$$

3. Check that the slope reproduces the vertical change.

$$m\Delta x = 2 \times 6 = 12 = \Delta y$$

Both coordinates increase, so a positive slope makes sense. Swapping both points preserves the slope; swapping only one subtraction changes it incorrectly.

Source checks & next step

OpenStax: percentages / OpenStax: slope / OpenStax: geometry / OpenStax: sample and population spread

Explore the full math formula library / Full previews and sources: toolarithm.com/resources/formula-sheets

TOOLARITHM / FORMULA SHEETS

Unit conversion sheet

Exact factors and temperature offsets

Factors use the international inch, foot and avoirdupois pound. Squared quantities need squared length factors. Binary storage prefixes are distinct from decimal SI prefixes.

Inches to centimetres

$$1\,\text{in} = 2.54\,\text{cm}$$

Exact international-inch definition. Multiply an inch value by this factor to obtain centimetres; divide to reverse the conversion.

Square feet to square metres

$$1\,\text{ft}^2 = 0.09290304\,\text{m}^2$$

Exact, from $1\,\text{ft} = 0.3048\,\text{m}$. Square the length factor for area. This is not the historical US survey foot.

Litres to cubic centimetres

$$1\,\text{L} = 1000\,\text{cm}^3$$

Also $1\,\text{mL} = 1\,\text{cm}^3$ exactly. Volume does not determine mass without a density for the material and its conditions.

Fahrenheit to Celsius

$$T_C = \frac{5}{9}(T_F - 32)$$

T_F and T_C are numerical temperature readings on the Fahrenheit and Celsius scales. For a temperature difference, use $\Delta T_C = 5\Delta T_F/9$ without the offset.

Pounds of mass to kilograms

$$1\,\text{lb} = 0.45359237\,\text{kg}$$

Exact for the international avoirdupois pound of mass. A pound-force is a force unit and requires a different conversion.

Binary storage to bytes

$$1\,\text{GiB} = 2^{30}\,\text{B}$$

Exactly $1\,073\,741\,824$ bytes. By contrast, $1\,\text{GB} = 10^9\,\text{B}$. A byte contains eight bits; keep the unit label with the number.

Worked example / Convert an area without a linear-factor error

Convert $12\,\text{ft}^2$ to square metres using the international foot. Display the final result to four decimal places.

1. Square the exact length conversion factor.

$$(0.3048)^2 = 0.09290304$$

2. Apply that area factor and retain all intermediate digits.

$$12 \times 0.09290304 = 1.11483648$$

3. Attach the square unit and round the final display.

$$12\,\text{ft}^2 \approx 1.1148\,\text{m}^2$$

The exact factor does not add precision to a measured input. Four decimal places here are a requested display choice, not a claim about measurement uncertainty.

Source checks & next step

NIST: SI conversion factors / NIST: binary prefixes

Check an area conversion / Full previews and sources: toolarithm.com/resources/formula-sheets

Scientific constants sheet

Defining constants and standard gravity

The first five values are exact SI defining constants. Standard gravity is an exact conventional reference, not a measurement of local gravitational acceleration. Measured inputs still carry uncertainty.

Speed of light in vacuum

$$c = 299\,792\,458\,\mathrm{m\,s^{-1}}$$

Exact SI defining constant. This is the speed in vacuum, not the propagation speed through an arbitrary material.

Planck constant

$$h = 6.62607015 \times 10^{-34}\,\mathrm{J\,s}$$

Exact SI defining constant. Preserve the exponent and the joule-second unit when using an energy-frequency relationship.

Elementary charge

$$e = 1.602176634 \times 10^{-19}\,\mathrm{C}$$

Exact, positive magnitude of the elementary charge. An electron has charge $-e$; the sign depends on the particle.

Avogadro constant

$$N_A = 6.02214076 \times 10^{23}\,\mathrm{mol^{-1}}$$

Exact SI defining constant. Specify the counted entity, such as atoms, molecules or ions, when connecting amount of substance and entity count.

Boltzmann constant

$$k_B = 1.380649 \times 10^{-23}\,\mathrm{J\,K^{-1}}$$

Exact SI defining constant. Absolute temperature in relationships using this constant is measured in kelvin, not Celsius readings.

Standard acceleration of gravity

$$g_n = 9.80665\,\mathrm{m\,s^{-2}}$$

Exact conventional value. For local weight use the appropriate local g; standard gravity does not describe every location or elevation.

Worked example / Weight under the standard-gravity convention

Use a mass of $2.000\,\mathrm{kg}$ with standard gravity. Report the force to four significant figures, matching the stated mass precision.

1. Choose the stated convention and distinguish mass from force.

$$W = m g_n$$

2. Multiply the mass by the conventional acceleration.

$$W = 2.000 \times 9.80665 = 19.6133\,\mathrm{N}$$

3. Round the force, not the defining reference value.

$$W \approx 19.61\,\mathrm{N}$$

This is a standard-gravity example. A local weight calculation needs local acceleration, and a precision statement should follow the actual measurement uncertainty.

Source checks & next step

BIPM: the SI defining constants / NIST: constants and conventional values

Convert force units / Full previews and sources: toolarithm.com/resources/formula-sheets