1. Basics

Typing an EXPRESSION (following Maple's > prompt) results in evaluating it. When the expression contains only integers (no decimal point), one gets the exact (rational) answer, as soon as at least one number in the expression is real (with a decimal point), the result is real (rounded off to 10 significant digits). The symbols $*$, / and ^ facilitate multiplication, division and exponentiation, respectively. Note that each line of your input has to end with a semicolon:

$> 4 * 5 - 3 / (5 + 2) + 2 \,\hat{}\, (-3) ;$

$$\frac{1103}{56}$$

The result of any computation can be stored under a name (which you make up, rather arbitrarily), and used in any subsequent expression. Maple then remembers the value, until the end of your session, or till you deliberately replace it with a new value. Note that this (giving a name to a result) is achieved by typing the name, followed by a colon and the equal sign (a group of two symbols, representing a single operation), followed by the actual expression to be stored:

$> \ a := (3.0 + 4) * (2 - 6) + 2 / 3 - 4 / 5 ;$

$$a := -28.13333333$$

$> \ a / 7 + 9 ;$

$$4.98095238$$

$> \ a := 14 / 6 ;$

$$a := \tfrac{7}{3} ;$$

$> \ a / 7 + 9 ;$

$$a := \tfrac{28}{3} ;$$

(from now on, we will omit the > prompt from our examples, showing only what *we* have to type).

Maple can also handle the usual functions such as **sin, cos, tan, arcsin, arccos, arctan, exp, ln, sqrt**, etc. All angles are always measured in radians.

$\mathbf{sin}(3.)\,;\ \mathbf{sqrt}(8)\,;$

$$.14112\,00081$$

$$2\sqrt{2}$$

We can also **define** our own functions by:

$f := x- > x\,\hat{}\,2\,;$

$$f := x \rightarrow x^2$$

$f(3);$

$$9$$

where f is an arbitrary name.

2. Lists and Loops

Maple can store, under a single name, a whole LIST of values, thus:

$a := [3\,/\,2,\ 5,\ \mathbf{sqrt}\,(3),\ 7]\,;$

$$a := [\tfrac{3}{2},\ 5,\ \sqrt{3},\ 7]$$

The individual elements of a list can be referenced by indexing (and used in computing another expression):

$a[2] * 4\,;$

$$20$$

One can add elements of a list by the following COMMAND (as Maple calls them):

$\mathbf{sum}(\text{'}a[i]\text{'},\text{'}i\text{'}= 1..4)\,;$

$$\tfrac{27}{2} + \sqrt{3}$$

One can convert the last answer to its decimal form by:

$\mathbf{evalf}(\%)\,;$

$$15.23205\,081$$

Note that the % symbol always refers to the previous expression.

Similarly to **sum**, one can also compute **product** of elements of a list.

To subtract say 3 from each element of the list a, redefining a correspondingly, can be achieved by:

for i **from** 1 **to** 4 **do** $a[i] := a[i] - 3$ **end do**:

Note that terminating a statement by : instead of the usual ; will prevent Maple from printing the four results computed in the process (we may not need to see them individually). Also note that, upon completion of this statement, i will have the value of 5 (any information i had contained previously will have been destroyed)!

We can easily verify that the individual elements of our a list have been updated accordingly:

$a[2]\,;$

$$2$$

We may also create a list using the following approach:

$b := [\,\mathbf{seq}\,(2\,\hat{}\,i, i = 1..6)]\,;$

$$b := [2,\ 4,\ 8,\ 16,\ 32,\ 64\,]\,;$$

3. Variables and Polynomials

If a symbol, such as for example x, has not been assigned a specific value, Maple considers it a variable. We may then define a to be a POLYNOMIAL in x, thus:

$a := 3 - 2 * x + 4 * x\hat{}2\,;$

$$a := 3 - 2\,x + 4\,x^2$$

A polynomial can be differentiated

diff$(a,\, x)$;

$$-2 + 8\,x$$

integrated from, say, 0 to 3

int$(\,a, x = 0\,..\,3)\,$;

$$36$$

or plotted, for a certain range of x values

plot$(\,a, x = 0..3)\,$;

We can also evaluate it, substituting a specific number for x (there are actually two ways of doing this):

subs$(x = 3, a)\,$; **eval**$(a,\; x = 3)$;

$$33$$

$$33$$

We can also multiply two polynomials (in our example, we will multiply a by itself), but to convert to a regular polynomial form, we nee to **expand** the answer:

$a * a\,$; **expand**$(\%)\,$;

$$(3 - 2\,x + 4\,x^2)^2$$

$$9 - 12\,x + 28\,x^2 - 16\,x^3 + 16\,x^4$$

4. Procedures

If some specific computation (consisting, potentially, of several steps) is to be done, more than once (e.g. we would like to be able to raise each element of a list of values to a given power), we need first to design the corresponding PROCEDURE (effectively a simple computer program), for example:

$RAISETO\;$:= **proc**$(L,\; N)\,$; **local** $K,\, n,\, i\,$; $K := L\,$; $n :=$ **nops**$(L)\,$;

for i **from** 1 **to** n **do** $K[i] := K[i] \,\hat{}\, N$ **end do**; K **end proc**:

where $RAISETO$ is an arbitrary name of the procedure, L and N are arbitrary names of its ARGUMENTS (also called parameters), the first for the list and the second for the exponent, K, n and i are auxiliary names to be used in the actual computation (since they are **local**, they will not interfere with any such names used outside the procedure). First we copy L into K (Maple does not like it if we try to modify L directly) and find its length n (by the **nops** command). Then, we raise each element K to the power of N, and return (the last expression of the procedure) the modified list. We can organize the procedure into several lines by using Shift-Enter (to move to the next line).

We can then use the procedure as follows:

$SVFL([2, 5, 7, 1], 2)$; $SVFL([3, 8, 4], -1)$;

$$[4, 25, 49, 1]$$

$$[\tfrac{1}{3}, \tfrac{1}{8}, \tfrac{1}{4}]$$

5. Statistical Distributions

These are available only after typing

with(stats):

We can then generate a random independent sample of a given size form the a variety of statistical distributions, e.g.

random[**binomiald**[10, 0.5]](30);

We can also compute the corresponding probabilities:

statevalf[**pf**,**binomiald**[10, 0.5]]([$0..10]);

and evaluate the distribution function:

statevalf[**cdf**,**normald**](1.2);

We can also get help with our combinatorics formulas:

binomial$(5,2)$;

finds the corresponding binomial coefficient $\binom{5}{2}$, and

with(**combinat**):

multinomial$(10,3,4,3)$;

yields the value of the multinomial coefficient $\binom{10}{3,4,3}$.

6. Plots

Plotting a specific function (or several functions) is easy (as we have already seen):

plot$(\ \{\sin(x), x - x\hat{}3/6\}, x = 0..Pi/2)$:

One can also plot a scattergram of individual points (it is first necessary to ask Maple to make to corresponding routine available, as follows:

with(plots) :

pointplot$(\ [[0,2],[1,-3],[3,0],[4,1],[7,-2]]);$

Note that the argument was a *list* of pairs of x-y values (each pair itself enclosed in brackets).

We can combine any two such plots (usually a scattergram of points together with a fitted polynomial) by:

$pic1 :=$ **pointplot**([**seq**($[i/5, \sin(i/5)], i = 1..7)]\ )$:

$pic2 :=$ **plot**$(\sin(x), x = 0..1.5)$:

display$(pic1, pic2)$:

To plot a function defined in a piecewise manner, we first define it by, say

$f :=$ **piecewise**$(x < 0, -x\hat{}2,\ x < 4, x\hat{}2,\ 4 * x)$:

(note that $4 * x$ will be used 'otherwise', i.e. for all x values bigger than 4), and then use the regular

$\mathbf{plot}(f, x = -5..10)\,;$

There are also a few special statistical plotting routines, e.g.

$a := [\mathbf{random}[\mathbf{binomiald}[10, 0.8]](300)]$:

$a := \mathbf{transform}[\mathbf{tallyinto}](a, [[i - 0.5..i + 0.5][1]\$i = 0..10])$:

$\mathbf{histogram}(a, \mathbf{area} = \mathbf{count})$;