Examples

2.1.4 Adding commonly used constants to the workspace

If you often use the same physical or mathematical constants in your MATLAB sessions, you can save them in an M-file and run it at the start of a session. For example, the following statements could be saved in `myconst.m`:

```
g = 9.8;                        % acceleration due to gravity
avo = 6.023e23;                 % Avogadro's number
e = 2.718281828459045;          % base of natural log
pi_4 = pi / 4;
log10e = log10( e );
bar_to_kP = 101.325;            % atmospheres to kiloPascals
```

If you run `myconst` at the start of a session these six variables will be part of the workspace and will be available for the rest of the session, or until you `clear` them. This approach to using MATLAB is like a notepad (it is one of many ways). As your experience with this tool grows, you will discover many more utilities and capabilities associated with this computational and analytical environment.

EXERCISE

1.1 Give values to variables `a` and `b` on the command line, e.g. `a = 3` and `b = 5`. Write some statements to find the sum, difference, product and quotient of `a` and `b`.

A number may also be represented in *scientific notation*, e.g. 1.2345×10^9 may be represented in MATLAB as `1.2345e9`. This is also called *floating point* notation. The number has two parts: the *mantissa*, which may have an optional decimal point (`1.2345` in this example) and the *exponent* (`9`), which must be an integer (signed or unsigned). Mantissa and exponent must be separated by the letter `e` (or `E`). The mantissa is multiplied by the power of 10 indicated by the exponent.

Note that the following is *not* scientific notation: `1.2345*10^9`. It is actually an *expression* involving two arithmetic operations (`*` and `^`) and therefore more time consuming.

Use scientific notation if the numbers are very small or very large, since there's less chance of making a mistake, e.g. represent 0.000000001 as `1e-9`.

On computers using standard floating point arithmetic, numbers are represented to approximately 16 significant decimal digits. The *relative accuracy* of numbers is given by the function `eps`, which is defined as the distance between 1.0 and the next largest floating point number. Enter `eps` to see its value on your computer.

The range of numbers is roughly $\pm 10^{-308}$ to $\pm 10^{308}$. Precise values for your computer are returned by the MATLAB functions `realmin` and `realmax`.

EXERCISES

1. Enter the following numbers at the command prompt in scientific notation (answers are below):

   1.234×10^5, -8.765×10^{-4}, 10^{-15}, -10^{12}.

   `(1.234e5, -8.765e-4, 1e-15, -1e12)`

Table 2.2 Precedence of arithmetic operations

Precedence	Operator
1	Parentheses (round brackets)
2	Power, left to right
3	Multiplication and division, left to right
4	Addition and subtraction, left to right

EXERCISES

1. Evaluate the following MATLAB expressions yourself before checking the answers in MATLAB:

```
1 + 2 * 3
4 / 2 * 2
1+2 / 4
1 + 2\4
2*2 ^ 3
2 * 3 \ 3
2 ^ (1 + 2)/3
1/2e-1
```

2. Use MATLAB to evaluate the following expressions. Answers are in brackets.

(a) $\frac{1}{2 \times 3}$ (0.1667)

(b) $2^{2 \times 3}$ (64)

(c) $1.5 \times 10^{-4} + 2.5 \times 10^{-2}$ (0.0252; use scientific or floating point notation)

2.4.5 The colon operator

The colon operator has a lower precedence than + as the following shows:

```
1+1:5
```

The addition is carried out first, and then a vector with elements 2, ..., 5 is initialized.

EXERCISES

1. Evaluate the following MATLAB expressions yourself (before you use MATLAB to check!). The numerical answers are in parentheses (or round brackets).

```
2 / 2 * 3                 (3)
2 / 3 ^ 2                 (2/9)
(2 / 3) ^ 2               (4/9)
2 + 3 * 4 - 4             (10)
2 ^ 2 * 3 / 4 + 3         (6)
2 ^ (2 * 3) / (4 + 3)     (64/7)
2 * 3 + 4                 (10)
2 ^ 3 ^ 2                 (64)
-4 ^ 2                    (−16; ^ has higher precedence than −)
```

2. Use MATLAB to evaluate the following expressions. The answers are in round brackets again.

a. $\sqrt{2}$ (1.4142; use `sqrt` or `^0.5`)

b. $\dfrac{3+4}{5+6}$ (0.6364; use brackets)

c. Find the sum of 5 and 3 divided by their product (0.5333)

d. 2^{3^2} (512)

e. Find the square of 2π (39.4784; use `pi`)

f. $2\pi^2$ (19.7392)

g. $1/\sqrt{2\pi}$ (0.3989)

h. $\dfrac{1}{2\sqrt{\pi}}$ (0.2821)

i. Find the cube root of the product of 2.3 and 4.5 (2.1793)

j. $\dfrac{1-\frac{2}{3+2}}{1+\frac{2}{3-2}}$ (0.2)

k. $1000(1+0.15/12)^{60}$ (2107.2, e.g. $1000 deposited for 5 years at 15 percent per year, with the interest compounded monthly)

l. $(0.0000123+5.678\times10^{-3})\times0.4567\times10^{-4}$ (2.5988×10^{-7}; use scientific notation, e.g. `1.23e-5` ...; do *not* use `^`)

3. Try to avoid using unnecessary brackets in an expression. Can you spot the errors in the following expression (test your corrected version with MATLAB):

```
(2(3+4)/(5*(6+1))^2
```