op_colon — Colon operators							
Description	Svntax	Remarks and examples	Conformability	Diagnostics	Also see		

Description

Colon operators perform element-by-element operations.

Syntax

а	:+	b	addition
а	:-	b	subtraction
а	:*	b	multiplication
а	:/	b	division
а	: ^	b	power
а	:==	b	equality
а	:!=	b	inequality
а	:>	b	greater than
а	:>=	b	greater than or equal to
а	:<	b	less than
а	:<=	b	less than or equal to
а	:&	b	and
а	:	b	or

Remarks and examples

Remarks are presented under the following headings:

C-conformability: element by element Usefulness of colon logical operators Use parentheses

C-conformability: element by element

The colon operators perform the indicated operation on each pair of elements of a and b. For instance,

$$\begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c*j & d*k \\ f*l & g*m \\ h*n & i*o \end{bmatrix}$$

Also colon operators have a relaxed definition of conformability:

$$\begin{bmatrix} c \\ f \\ g \end{bmatrix} :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c*j & c*k \\ f*l & f*m \\ g*n & g*o \end{bmatrix}$$
$$\begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* \begin{bmatrix} j \\ l \\ n \end{bmatrix} = \begin{bmatrix} c*j & d*j \\ f*l & g*l \\ h*n & i*n \end{bmatrix}$$
$$\begin{bmatrix} c & d \end{bmatrix} :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c*j & d*k \\ c*l & d*m \\ c*n & d*o \end{bmatrix}$$
$$\begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* \begin{bmatrix} l & m \end{bmatrix} = \begin{bmatrix} c*l & d*m \\ f*l & g*m \\ h*l & i*m \end{bmatrix}$$
$$c :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c*l & d*m \\ f*l & g*m \\ h*l & i*m \end{bmatrix}$$
$$\begin{bmatrix} c & si & c*k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c*j & c*k \\ c*l & c*m \\ c*n & c*o \end{bmatrix}$$
$$\begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c*j & c*k \\ c*l & c*m \\ c*n & c*o \end{bmatrix}$$

The matrices above are said to be c-conformable; the c stands for colon. The matrices have the same number of rows and columns, or one or the other is a vector with the same number of rows or columns as the matrix, or one or the other is a scalar.

C-conformability is relaxed, but not everything is allowed. The following is an error:

$$(c d e) :* \begin{bmatrix} f \\ g \\ h \end{bmatrix}$$

Usefulness of colon logical operators

It is worth paying particular attention to the colon logical operators because they can produce pattern vectors and matrices. Consider the matrix

Which elements of x contain 0?

:	x:==0					
		1	2			
	1	0	1			
	2	1	0			
	3	0	0			

How many zeros are there in x?

```
: sum(x:==0)
2
```

Use parentheses

Because of their relaxed conformability requirements, colon operators are not associative even when the underlying operator is. For instance, you expect (a+b)+c == a+(b+c), at least ignoring numerical roundoff error. Nevertheless, (a:+b):+c == a:+(b:+c) does not necessarily hold. Consider what happens when

 $\begin{array}{ll}a: & 1 \times 4\\b: & 5 \times 1\\c: & 5 \times 4\end{array}$

Then (a:+b):+c is an error because a:+b is not c-conformable.

Nevertheless, a:+(b:+c) is not an error and in fact produces a 5×4 matrix because b:+c is 5×4 , which is c-conformable with a.

For nonassociative operations, parentheses are useful when using colon operators for even the most basic computations. For example, consider the column vectors

 $: x = (4 \setminus 5 \setminus 6)$ $: y = (1 \setminus 2 \setminus 3)$

Below, we attempt to compute 4-x-y with two different statements. The actual computations that are performed are listed as comments:

As stated in [M-2] Syntax, an operator preceded by a colon (that is, a colon operator) has lower precedence than the operator itself. This is why Mata first subtracts y from x in the second statement above. But, if you plan to use a combination of operators and colon operators, you can still set the precedence with parentheses:

```
: (4 :- x) - y /* (4-x)-y */

1

1

1

2

-3

3

-5
```

This produces the desired result and the same output as the first statement above.

Conformability

a :*op b*:

a: $r_1 \times c_1$ b: $r_2 \times c_2$, a and b c-conformable result: $\max(r_1, r_2) \times \max(c_1, c_2)$

Diagnostics

The colon operators return missing and abort with error under the same conditions that the underlying operator returns missing and aborts with error.

Also see

[M-2] exp — Expressions

[M-2] Intro — Language definition

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