

**lowertriangle()** — Extract lower or upper triangle

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## Description

`lowertriangle()` returns the lower triangle of  $A$ .

`uppertriangle()` returns the upper triangle of  $A$ .

`_lowertriangle()` replaces  $A$  with its lower triangle.

`_uppertriangle()` replaces  $A$  with its upper triangle.

## Syntax

*numeric matrix*    `lowertriangle(numeric matrix  $A$  [ , numeric scalar  $d$  ])`

*numeric matrix*    `uppertriangle(numeric matrix  $A$  [ , numeric scalar  $d$  ])`

*void*                `_lowertriangle(numeric matrix  $A$  [ , numeric scalar  $d$  ])`

*void*                `_uppertriangle(numeric matrix  $A$  [ , numeric scalar  $d$  ])`

where argument  $d$  is optional.

## Remarks and examples

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Remarks are presented under the following headings:

*Optional argument  $d$*   
*Nonsquare matrices*

### Optional argument $d$

Optional argument  $d$  specifies the treatment of the diagonal. Specifying  $d > .$ , or not specifying  $d$  at all, means no special treatment; if

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

then

$$\text{lowertriangle}(A, .) = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 5 & 0 \\ 7 & 8 & 9 \end{bmatrix}$$

If a nonmissing value is specified for  $d$ , however, that value is substituted for each element of the diagonal, for example,

$$\text{lowertriangle}(A, 1) = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 7 & 8 & 1 \end{bmatrix}$$

### Nonsquare matrices

`lowertriangle()` and `uppertriangle()` may be used with nonsquare matrices. If

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix}$$

then

$$\text{lowertriangle}(A) = \begin{bmatrix} 1 & 0 & 0 \\ 5 & 6 & 0 \\ 9 & 10 & 11 \end{bmatrix}$$

and

$$\text{uppertriangle}(A) = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & 6 & 7 & 8 \\ 0 & 0 & 11 & 12 \end{bmatrix}$$

`_lowertriangle()` and `_uppertriangle()`, however, may not be used with nonsquare matrices.

### Conformability

`lowertriangle(A, d)`:

$A$ :  $r \times c$   
 $d$ :  $1 \times 1$  (optional)  
*result*:  $r \times \min(r, c)$

`uppertriangle(A, d)`:

$A$ :  $r \times c$   
 $d$ :  $1 \times 1$  (optional)  
*result*:  $\min(r, c) \times c$

`_lowertriangle(A, d)`, `_uppertriangle(A, d)`:

*input*:

$A$ :  $n \times n$   
 $d$ :  $1 \times 1$  (optional)

*output*:

$A$ :  $n \times n$

## Diagnostics

None.

## Also see

[M-4] [manipulation](#) — Matrix manipulation