Title

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qrinv( ) — Generalized inverse of matrix via QR decomposition

Syntax

numeric matrix `qrinv(numeric matrix` *A*`)`

numeric matrix `qrinv(numeric matrix` *A*`,` *rank*`)`

numeric matrix `qrinv(numeric matrix` *A*`,` *rank*`,` *real scalar tol*`)`

real scalar `_qrinv(numeric matrix` *A*`)`

real scalar `_qrinv(numeric matrix` *A*`,` *real scalar tol*`)`

where the type of *rank* is irrelevant; the rank of *A* is returned there.

Description

`qrinv(`*A*`, ...)` returns the inverse or generalized inverse of real or complex matrix *A*: $m \times n$, $m \geq n$. If optional argument *rank* is specified, the rank of *A* is returned there.

`_qrinv(`*A*`, ...)` does the same thing except that, rather than returning the result, it overwrites the original matrix *A* with the result. `_qrinv()` returns the rank of *A*.

In both cases, optional argument *tol* specifies the tolerance for determining singularity; see *Remarks and examples* below.

Remarks and examples

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`qrinv()` and `_qrinv()` are most often used on square and possibly rank-deficient matrices but may be used on nonsquare matrices that have more rows than columns. Also see [M-5] **pinv( )** for an alternative. See [M-5] **luinv( )** for a more efficient way to obtain the inverse of full-rank, square matrices, and see [M-5] **invsym( )** for inversion of real, symmetric matrices.

When *A* is of full rank, the inverse calculated by `qrinv()` is essentially the same as that computed by the faster `luinv()`. When *A* is singular, `qrinv()` and `_qrinv()` compute a generalized inverse, *A**, which satisfies

$$A(A^*)A = A$$

$$(A^*)A(A^*) = A^*$$

This generalized inverse is also calculated for nonsquare matrices that have more rows than columns and, then returned is a least-squares solution. If *A* is $m \times n$, $m \geq n$, and if the rank of *A* is equal to *n*, then $(A^*)A = I$, ignoring roundoff error.

`qrinv(`*A*`)` is implemented as `qrsolve(`*A*`, I(rows(`*A*`)))`; see [M-5] **qrsolve( )** for details and for use of the optional *tol* argument.

Conformability

`qrinv(`*A*`,` *rank*`,` *tol*`)`:

input:			
	A:	$m \times n$,	$m \geq n$
	tol:	1×1	(optional)
output:			
	rank:	1×1	(optional)
	result:	$n \times m$	

`_qrinv(`*A*`,` *tol*`)`:

input:			
	A:	$m \times n$,	$m \geq n$
	tol:	1×1	(optional)
output:			
	A:	$n \times m$	
	result:	1×1	(containing rank)

Diagnostics

The inverse returned by these functions is real if *A* is real and is complex if *A* is complex.

`qrinv(`*A*`, ...)` and `_qrinv(`*A*`, ...)` return a result containing missing values if *A* contains missing values.

`_qrinv(`*A*`, ...)` aborts with error if *A* is a view.

See [M-5] **qrsolve( )** and [M-1] **tolerance** for information on the optional *tol* argument.

Also see

[M-5] **invsym( )** — Symmetric real matrix inversion

[M-5] **cholinv( )** — Symmetric, positive-definite matrix inversion

[M-5] **luinv( )** — Square matrix inversion

[M-5] **pinv( )** — Moore–Penrose pseudoinverse

[M-5] **qrsolve( )** — Solve AX=B for X using QR decomposition

[M-5] **solve_tol( )** — Tolerance used by solvers and inverters

[M-4] **matrix** — Matrix functions

[M-4] **solvers** — Functions to solve AX=B and to obtain A inverse