

qrinv() — Generalized inverse of matrix via QR decomposition

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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.

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.

Remarks and examples

`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

$$\begin{aligned}
 A(A^*)A &= A \\
 (A^*)A(A^*) &= A^*
 \end{aligned}$$

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] `cholinv()` — Symmetric, positive-definite matrix inversion

[M-5] `invsym()` — Symmetric real 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