solve_tol() — Tolerance used by solvers and inverters

Description

solve_tol(Z, usertol) returns the tolerance used by many Mata solvers to solve $AX = B$ and by many Mata inverters to obtain $A^{-1}$. usertol is the tolerance specified by the user or is missing value if the user did not specify a tolerance.

Syntax

real scalar solve_tol(numeric matrix Z, real scalar usertol)

Remarks and examples

The tolerance used by many Mata solvers to solve $AX = B$ and by many Mata inverters to obtain $A^{-1}$ is

$$
eta = s \cdot \frac{\text{trace}(|Z|)}{n}
$$

(1)

where $s = 1e-13$ or a value specified by the user, $n$ is the min(rows(Z), cols(Z)), and $Z$ is a matrix related to $A$, usually by some form of decomposition, but could be $A$ itself (for instance, if $A$ were triangular). See, for instance, [M-5] solvelower() and [M-5] cholsolve().

When $usertol > 0$ and $usertol < .$ is specified, solvetol() returns $eta$ calculated with $s = usertol$.

When $usertol \leq 0$ is specified, solvetol() returns $-usertol$.

When $usertol \geq .$ is specified, solvetol() returns a default result, calculated as

1. If external real scalar _solvetolerance does not exist, as is usually the case, the value of $eta$ is returned using $s = 1e-13$.

2. If external real scalar _solvetolerance does exist,

   a. If _solvetolerance $> 0$, the value of $eta$ is returned using $s = _solvetolerance$.

   b. If _solvetolerance $\leq 0$, $-_-_solvetolerance$ is returned.

Conformability

solve_tol(Z, usertol):

- $Z$: $r \times c$
- $usertol$: $1 \times 1$
- $result$: $1 \times 1$
Diagnostics

\texttt{solve\_tol(Z, usertol)} skips over missing values in \( Z \) in calculating (1); \( n \) is defined as the number of nonmissing elements on the diagonal.

Also see

[M-4] \textbf{Utility} — Matrix utility functions