MATRIX DETERMINANT

PURPOSE

Compute the determinant of a square matrix.

DESCRIPTION

The determinant of an NxN matrix A is defined as:

$$\det A = A_{11}a_1 - A_{12}a_2 + A_{13}a_3 - ... - (-1)^{(N+1)}*A_{1n}a_n$$

where A_{1j} is the entry in row 1 and column j of A and a_j is the determinant of the matrix obtained by omitting the first row and column j of A. This is a recursive definition. The determinant of a 2x2 matrix:

[a b]
[c d]

is ad - bc.

A determinant of zero means that a matrix is singular and does not have an inverse. Values close to zero indicate that a matrix is near singular (and that there may be numerical difficulties in calculating the inverse).

In practice, the determinant, the matrix inverse, and the solution to a system of equations are all closely related. Each of these can be calculated from the LU decomposition of a matrix. After an LU decomposition, the determinant is simply the product of the diagonal elements of the LU decomposed matrix.

SYNTAX

LET <par> = MATRIX DETERMINANT <mat>   <SUBSET/EXCEPT/FOR qualification>

where <mat> is a matrix for which the determinant is to be computed;

    <par> is a parameter where the resulting determinant is saved;

and where the <SUBSET/EXCEPT/FOR qualification> is optional and rarely used in this context.

EXAMPLES

LET C = MATRIX DETERMINANT A

NOTE 1

Matrices for which a determinant is to be computed must have the same number of rows and columns. An error message is printed if they do not.

NOTE 2

DATAPLOT uses LINPACK routines to calculate the LU decomposition (versions prior to 7/93 use the LUDCMP and LUBKSB routines from the Numerical Recipes book).

The reciprocal of the condition number is printed. This number gives an indication of the numerical accuracy that was obtained when calculating the determinant. If this number is approximately $10^{**(-d)}$, then the elements of the LU decomposed matrix generally have d fewer significant digits than the original matrix. If this number is effectively zero, then DATAPLOT does not try to compute the determinant.

DEFAULT

None

SYNONYMS

None

RELATED COMMANDS

MATRIX ADJOINT	=	Compute the adjoint matrix of a matrix.
MATRIX COFACTOR	=	Compute a matrix cofactor.
MATRIX INVERSE	=	Compute a matrix inverse.
MATRIX MINOR	=	Compute a matrix minor.
MATRIX RANK	=	Compute the rank of a matrix.
MATRIX SOLUTION	=	Solve a system of linear equations.
TRIANGULAR SOLVE	=	Solve a triangular system of equations.
TRIDIAGONAL SOLVE	=	Solve a tridiagonal system of equations.

MATRIX TRACE   =   Compute a matrix trace.

REFERENCE
"LINPACK User's Guide," Dungarra, Bunch, Moler, and Stewart, Siam, 1979.

"Numerical Recipes: The Art of Scientific Programming (FORTRAN Version)," Press, Flannery, Teukolsky, and Vetterling. Cambridge University Press, 1989 (chapter 2).

APPLICATIONS
Linear Algebra

IMPLEMENTATION DATE
87/10

PROGRAM
```
READ MATRIX X
16 16 19 21 20
14 17 15 22 18
24 23 21 24 20
18 17 16 15 20
18 11  9 18  7
END OF DATA
LET A = MATRIX DETERMINANT X
PRINT A
```

A value of 35140.01 is returned for the determinant.