

## TRIDIAGONAL SOLUTION

### PURPOSE

Solve a system of linear equations in the following form:

$$A * X = B$$

where A is a tridiagonal matrix of coefficients, B is a vector of constants, and X are the variables to be solved for.

### DESCRIPTION

A tridiagonal matrix is one with entries on the diagonal, the super-diagonal, and the sub-diagonal only. All other entries are zero. Solving a tridiagonal system allows simplifications that provide a faster solution than the standard LU decomposition used by the MATRIX SOLUTION command. The TRIDIAGONAL SOLUTION command also stores each of the diagonals (main, super, sub) as variables rather than a matrix, so it can handle much larger problems than the MATRIX SOLUTION command.

If the diagonal has N elements, then the sub-diagonal and super-diagonal each have N-1 elements. However, when creating the variables for DATAPLOT, the first element of the sub-diagonal and the last element of the super-diagonal should be dummy zeros. This means that the variables containing the sub-diagonal and super-diagonal will be the same size as the variable containing the diagonal elements.

### SYNTAX

LET <resp> = TRIDIAGONAL SOLUTION <subd> <diag> <superd> <b> <SUBSET/EXCEPT/FOR qualification>

where <subd> is a variable containing the elements of the sub-diagonal of the coefficient matrix;

<diag> is a variable containing the elements of the diagonal of the coefficient matrix;

<superd> is a variable containing the elements of the super-diagonal of the coefficient matrix;

<b> is an array of constants (i.e., the values for the right hand side of the equation);

<resp> is a vector where the resulting tridiagonal solution is saved;

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

### EXAMPLES

LET X = TRIDIAGONAL SOLUTION C DIAG E B

### NOTE 1

DATAPLOT uses the LINPACK routine SGTSL to solve the tridiagonal system.

### NOTE 2

The sub-diagonal, diagonal, and super-diagonal variables must have the same number of rows. An error message is printed if they do not. The first element of the sub-diagonal variable and the last element of the super-diagonal variable are dummy elements.

### DEFAULT

None

### SYNONYMS

TRIDIAGONAL SOLVE

### RELATED COMMANDS

MATRIX DETERMINANT	=	Compute a matrix determinant.
MATRIX INVERSE	=	Compute a matrix inverse.
MATRIX SIMPLEX SOLUTION	=	Compute a matrix simplex solution.
MATRIX SOLUTION	=	Solve a system of linear equations.
TRIANGULAR INVERSE	=	Compute a triangular matrix inverse.
TRIANGULAR SOLUTION	=	Solve a triangular system of linear equations.

### REFERENCE

"LINPACK User's Guide," Dongarra, 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**

93/10

**PROGRAM**

```
. TEST TRIDIAGONAL SYSTEM (ANSWER SHOULD BE: 4 -8 -7 9)
LET C = DATA 0 0 -4 9
LET D = DATA 6 4 -4 -9
LET E = DATA -3 7 -8 0
LET B = DATA 48 -81 -12 -144
LET S = TRIDIAGONAL SOLVE C D E B
PRINT S
```

Values of 4, -8, -7, and 9 are printed for the variable S.