# CHAPTER 4 Matrix LET Subcommands

DATAPLOT supports a large range of matrix capabilities as LET subcommands. Matrix commands can be combined to perform many analyses not supported directly by DATAPLOT. This is particularly true for many multivariate statistical techniques. For example, the sample programs in this chapter demonstrate canonical correlation, Fisher's discriminant analysis, biplots, and principal components regression. These are available as programs in the DATAPLOT reference directory. This is discussed in chapter 14 of Volume I.

**Solving systems of equations, determinants, and inverses**

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| MATRIX DETERMINANT | Compute the determinant of a matrix. |
| MATRIX INVERSE | Compute the inverse of a matrix. |
| MATRIX SOLUTION | Compute a solution to a system of linear equations. |
| MATRIX ITERATIVE SOLUTION | Compute a solution to system of linear equations and apply iterative improvement. |
| MATRIX SIMPLEX SOLUTION | Compute a matrix simplex solution. |
| TRIANGULAR SOLVE | Compute a solution to a triangular system of linear equations. |
| TRIANGULAR INVERSE | Compute the inverse of a triangular matrix. |
| TRIDIAGONAL SOLVE | Compute a solution to a tridiagonal system of linear equations. |

**Eigenvalues and eigenvectors**

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| MATRIX EIGENVALUES | Compute the eigenvalues of a matrix. |
| MATRIX EIGENVECTORS | Compute the eigenvectors of a matrix. |

**Matrix decompositions**

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| CHOLESKY DECOMPOSITION | Compute the Cholesky decomposition of a matrix. |
| SINGULAR VALUES | Compute the singular values of a matrix. |
| SINGULAR VALUE DECOMP | Compute the singular value decomposition of a matrix. |
| SINGULAR VALUE FACTOR | Compute the singular value factorization of a matrix. |

**Matrix arithmetic and procedures**

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| MATRIX ADDITION | Compute a matrix addition. |
| MATRIX MULTIPLICATION | Compute a matrix multiplication. |
| MATRIX SUBTRACTION | Compute a matrix subtraction. |
| CORRELATION MATRIX | Compute the correlation matrix of a matrix. |
| VARIANCE-COVA MATRIX | Compute the variance-covariance matrix of a matrix. |
| MATRIX EUCLIDEAN NORM | Compute the euclidean norm of a matrix. |
| MATRIX SPECTRAL NORM | Compute the spectral norm of a matrix. |
| MATRIX SPECTRAL RADIUS | Compute the spectral radius of a matrix. |
| PRINCIPAL COMPONENTS | Compute the principal components of a matrix. |
| PRINCIPAL COMP EIGENVALUE | Compute the principal component eigenvalues of a matrix. |

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| PRINCIPAL COMP EIGENVECTOR | Compute the principal component eigenvectors of a matrix. |

**Matrix utility routines**

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| DIAGONAL MATRIX | Generate a diagonal matrix. |
| MATRIX ADJOINT | Compute the adjoint matrix of a matrix. |
| MATRIX AUGMENT | Append columns to a matrix. |
| MATRIX COFACTOR | Compute the cofactors of a matrix. |
| MATRIX DEFINITION | Set a matrix definition. |
| MATRIX DIAGONAL | Extract the diagonal of a matrix. |
| MATRIX ELEMENT | Extract an element of a matrix. |
| MATRIX MINOR | Compute the minors of a matrix. |
| MATRIX NUMBER OF COLUMNS | Compute the number of columns in a matrix. |
| MATRIX NUMBER OF ROWS | Compute the number of rows in a matrix. |
| MATRIX RANK | Compute the rank of a matrix. |
| MATRIX REPLACE ELEMENT | Replace an element in a matrix. |
| MATRIX REPLACE ROW | Replace a row in a matrix. |
| MATRIX ROW | Copy a row of a matrix into a variable. |
| MATRIX SUBMATRIX | Define a matrix submatrix. |
| MATRIX TRACE | Compute the trace of a matrix. |
| MATRIX TRANSPOSE | Compute the transpose of a matrix. |

**General considerations**

Matrices are created with either the READ MATRIX command or the MATRIX DEFINITION command. See the documentation for MATRIX DEFINITION and READ MATRIX for details.

The columns of a matrix are accessible as variables by appending an index to the matrix name. For example, the 4x4 matrix C has columns C1, C2, C3, and C4. These columns can be operated on like any other DATAPLOT variable. At this time, there is no automatic way to refer to the rows of a matrix.

The maximum size of the matrices DATAPLOT can operate on is set when DATAPLOT is compiled on your system. The default maximums are 750 rows and 100 columns for a single matrix. If this is not adequate, contact your site installer for assistance in increasing the limit. Each column of a matrix is also saved as a distinct variable, so if you have a large number of columns in several matrices be aware that maximum number of names for variables, parameters, and strings is 500. Earlier versions of DATAPLOT may have significantly smaller limits for the maximum number of rows and columns.

DATAPLOT uses the LINPACK and EISPACK libraries for many of its linear algebra operations. These are high quality public domain Fortran based libraries for many linear algebra functions. The documentation for the individual commands specifies which, if any, routine is used from these libraries.