

Mathlab and MATLAB 6

1. The 4th MATLAB handout showed you how to use MATLAB to solve a system of linear equations. Now a more systematic look will be taken at the use of MATLAB in dealing with matrices and vectors.

2. To enter a matrix, e.g. $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, type

$$A = [1 \ 2 ; 3 \ 4];$$

To enter a column vector, e.g. $v = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, type

$$v = [0 ; 1];$$

To enter a row vector, e.g. $u = [4, 5, 6]$, type

$$u = [4, 5, 6];$$

3. To add two vectors or matrices, v and w of the same size, type

$$v + w$$

To multiply matrix A times vector v , type

$$A * v$$

If B is also a matrix, to multiply A and B , type

$$A * B$$

4. Try out these commands on some examples. The commands

$$C = \text{rand}(n)$$

$$D = \text{rand}(m, n)$$

generate an $n \times n$ and $m \times n$ matrices and can be used to construct examples.

5. The system of linear equations

$$a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n = b_1$$

$$a_{n1}x_1 + a_{n2}x_2 + \cdots + a_{nn}x_n = b_n$$

can be written in the form $Ax = b$ where A is the coefficient matrix (a_{ij}) and x and b are column n -vectors. If the determinant of A is non-zero, the solution can be obtained by typing

$$x = A \backslash b.$$

To calculate the determinant of A , type

$$\det(A)$$

6. To find the eigenvalues of A , type

$$\text{eig}(A)$$

When A possesses distinct eigenvectors the command

$$[V, E] = \text{eig}(A)$$

produces two matrixes: V whose columns are the eigenvectors of A (normalized so that the sum of the squares of the components of each eigenvector equals 1) and E whose diagonal entries are the corresponding eigenvalues of A . Typing

$$\text{diag}(E)$$

gives the diagonal elements of matrix E , i.e. in this case, the eigenvalues of A . The individual eigenvectors can be obtained by typing

$$v_1 = V(:, 1)$$

etc.

7. a. Solve the IVP $x' = Ax, x(0) = \begin{pmatrix} 2 \\ 2 \\ 3 \end{pmatrix}$ where

$$A = \begin{pmatrix} -3 & 1 & -3 \\ -8 & 3 & -6 \\ 2 & -1 & 2 \end{pmatrix}$$

- b. On a single graph, plot the components $x_1(t), x_2(t), x_3(t)$ of the solution $x(t)$ over the interval $[-1, 1]$ using e.g. ' - -' for x_2 and ' - .' for x_3 . Use enough points so that the graph looks smooth.

8. a. Solve the IVP $x' = Ax, x(0) = \begin{pmatrix} 0 \\ -3 \\ 1 \end{pmatrix}$ where

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

- b. Proceed as in 7b on the interval $-0.1 \leq t \leq 0.1$.

9. Hand in 7ab and 8ab.