Selected Solutions for Exercises in

Numerical Methods with MATLAB: Implementations and Applications

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Chapter 2

Interactive Computing with MATLAB

The latest version of this PDF file, along with other supplemental material for the book, can be found at `www.prenhall.com/recktenwald`.

2–1 Use the `lookfor` command to search for functions associated with the string "max." From the list of functions returned, use the `help` facility to determine the function that finds the maximum of all entries in a matrix. Apply this function to find the largest entry in the following matrices:

$$A = \begin{bmatrix} 1 & -5 & -2 \\ 3 & 4 & -9 \\ -7 & 2 & 6 \end{bmatrix}; \qquad B = \begin{bmatrix} \sin(1) & \sin(-5) & \sin(-2) \\ \sin(3) & \sin(4) & \sin(-9) \\ \sin(-7) & \sin(2) & \sin(6) \end{bmatrix}$$

Solution: Given a vector as input, the `max` function returns the maximum element. Given a matrix as input, the `max` function returns a row vector containing the maximum element in each column of the matrix. To find the maximum element in the matrix, apply `max` twice. Notice that the arguments of the sine function in matrix B are the elements of A.

```
>> lookfor max     % ... returns long list of built-in functions

>> help max        % ... returns documentation on max function

>> A = [ 1 -5 -2; 3 4 -9; -7 2 6];
>> max(max(A))
ans =
    6

>> B = sin(A)
B =
    0.8415    0.9589   -0.9093
    0.1411   -0.7568   -0.4121
   -0.6570    0.9093   -0.2794
>> max(max(B))
ans =
    0.9589
```

2–5 Use the `linspace` function to create vectors identical to those obtained with the statements that follow. Use multiple statements where necessary. (Use MATLAB's built-in `norm` function to test whether two vectors are equal *without* printing the elements.)

(a) `x = 0:10`

(b) `x = 0:0.2:10`

(c) `x = -12:12`

(d) `x = 10:-1:1`

Partial Solution: The table below gives equivalent `linspace` expressions for the colon notation expressions in the first column. To test whether these statements are correct, enter the commands to create `x` and `y`, and then compute `norm(x-y)`.

colon notation	`linspace`
`x = 0:10`	`y = linspace(0,10,11)`
`x = -12:12`	`y = linspace(-12,12,25)`

2–9 Given the row vector $x = \begin{bmatrix} 10 & 9 & 8 & 7 \end{bmatrix}$ and column vector

$$y = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$$

write at least two different ways to compute the *row vector* z defined by $z_i = x_i - y_i$. Your answers should take only one assignment operation. Do not, for example, explicitly write out equations for all of the elements of z.

Partial Solution: One of the less obvious ways to create z is `z = ( x' - y )'`.

2–15 Use the `eye` and `fliprl` functions to create the matrix

$$E = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

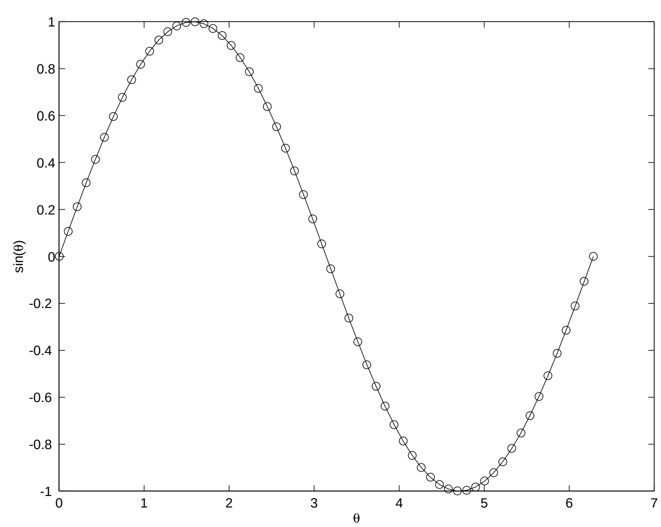
Does the same trick work with `flipud`?

Typographical Error: `fliprl` should be `fliplr`.

Solution: `E = fliplr(eye(3))`. Yes, `E = flipud(eye(3))` also works.

2–24 Plot $\sin\theta$ versus θ for 60 points in the interval $0 \leq \theta \leq 2\pi$. Connect the points with a dashed line *and* label the points with open circles. (*Hint*: Users of MATLAB version 4 will need to plot the data twice in order to combine the symbol and line plots.)

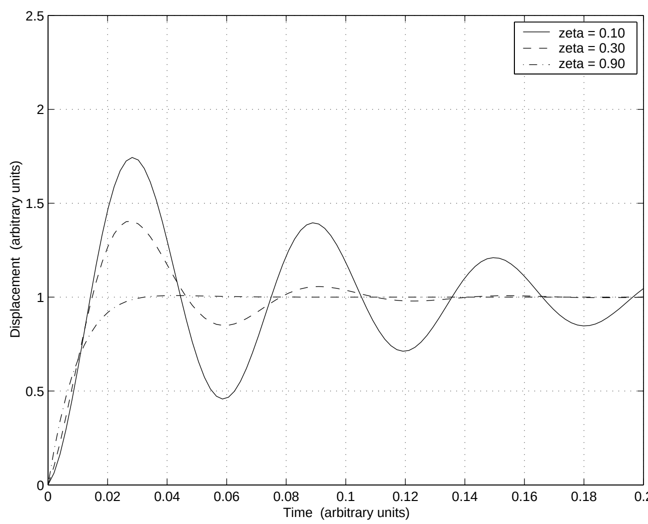
Partial Solution: The correct MATLAB statements produce the following plot



Plot of solution to **Exercise 2–24**.

2–25 Create a plot of the response of a second-order system with $\zeta = 0$, $\zeta = 0.3$, and $\zeta = 0.9$. Use the formula in Example 2.2, and combine the response curves for all three ζ values on the same plot. Label the axes and identify the curves with a legend.

Partial Solution: The correct MATLAB statements produce the following plot



Plot of solution to **Exercise 2–25**.

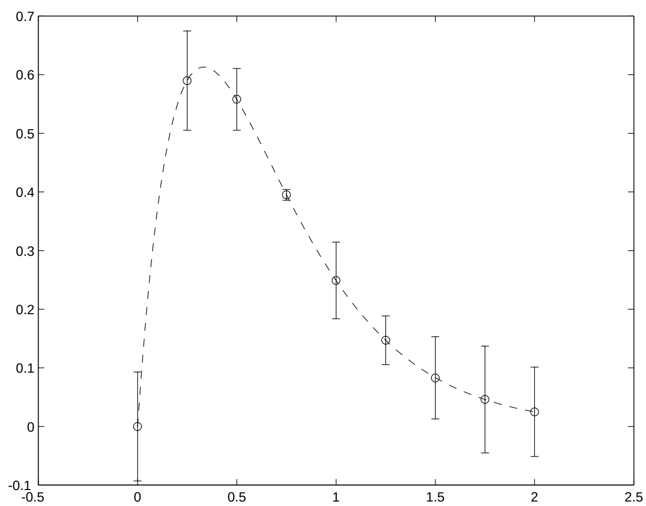
2–30 Data in the table that follows were obtained from an experiment in which the theoretical model is $y = 5x\exp(-3x)$. The x_m and y_m values were measured, and the δ_y values were obtained from an uncertainty analysis. Use the built-in `errorbar` function to create a plot of the experimental data with error bars. Use the `hold on` and `plot` functions to overlay a plot of the measured data with the theoretical model. The data are stored in the `xydy.dat` file in the `data` directory of the NMM toolbox.

x_m	0.010	0.223	0.507	0.740	1.010	1.220	1.530	1.742	2.100
y_m	0.102	0.620	0.582	0.409	0.312	0.187	0.122	0.081	0.009
δ_y	0.0053	0.0490	0.0671	0.0080	0.0383	0.0067	0.0417	0.0687	0.0589

Partial Solution: The data can be read with the following statements

```
D = load('xydy.dat');   x = D(:,1);   y = D(:,2);   dy = D(:,3);
```

The desired plot is shown below



Plot of solution to **Exercise 2–30**.