

## Assignment 6: Matlab Practice and Plots

Date Due: March 22, 2012

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### Problem 1

A civil engineer sends you a “comma separated” data file containing aircraft characteristics used in airport design. The first few lines of the file look as follows:

Adam Aircraft Industries,A500,7000 ,98,44.00,9.58

Aero Spacelines,B-377,170000 ,123,156.25,48.50

Aeronca,11AC Chief,1250 ,64,36.00,6.00

Aeronca,15AC Sedan,2050 ,67,37.50,10.33

Aerospatiale,ATR-42-320,36817 ,124,80.58,24.92

The six columns of each record are explained below. The file name is “aircraft\_characteristics\_noheader\_csv.csv”.

Column 1 = aircraft name

Column 2 = manufacturer name

Column 3 = aircraft takeoff weight (lb)

Column 4 = aircraft approach speed (nautical miles per hour)

Column 5 = aircraft wingspan (feet)

Column 6 = aircraft tail height (feet)

### Task 1

Create a Matlab script to read the complete data in this file in 6 column format. Use the Matlab “textscan” command with a comma delimiter. An example of the command is shown below:

```
readData = textscan(fid, '%s %s %f %f %f %f', 'delimiter', ',');
```

Do not forget to add the lines to open and close the file.

### Task 2

**Enhance the Matlab script created in Task 1 and** create 6 variables with the information contained in each column of the file read in Task 1. Label these variables with names that can be used later in the analysis.

### Task 3

Modify the Matlab script created in Task 3 to find the aircraft whose takeoff mass is greater or equal than 255,000 lb. The Federal Aviation Administration calls this aircraft as “heavy”. Create a variable that contains the names of these aircraft and count the number of aircraft in this group. Find the average takeoff weight of this group of aircraft.

### Task 4

Modify the Matlab script created in Task 3 to plot the aircraft takeoff weight vs. the aircraft tail height. Comment on the relationship observed.

## Problem 2

A high-speed train (shown in Figure 2) accelerates according to the following formula:

$$a(t) = \frac{dV}{dt} = k_1 - k_2V$$

where  $a(t) = \frac{dV}{dt}$  is the rate of change of velocity over time (m/s-s) - acceleration,  $V$  is the train speed in m/s and  $k_1, k_2$  are two constants that relate the acceleration of the train as a function of speed. For a High-Speed train the values of  $k_1$  is 2.1 (m/s-s) and  $k_2 = 0.023$  (1/second).



Figure 2. High-Speed Train (Amtrak Acela Train).

### Task 1

**Create a Matlab script** to calculate the acceleration of the train as a function of speed. In this script save two vectors containing the values of speed and acceleration.

### Task 2

Plot the speed of the train (x-axis) and the acceleration (y-axis). Label your axes and headings accordingly. Comment on the trends observed.

### Task 3

Change the attributes of the plot created in Task 2 as follows:

- Line depicting acceleration profile should be blue
- Line width should be 3
- Font size of the X and Y labels should be 24
- Font size of the X and Y numbers should be 20

## Problem 3

### Task 1

Create a Matlab script to:

a) Load the Autobahn data file in Matlab (see week 1 of the syllabus to retrieve the Autobahn file). The data contains two columns as shown below.

```
% Traffic Flow Data
%
% Autobahn data
%
% Column 1 = Density (veh/km-lane)
% Column 2 = Speed (km/hr)
0.08 160.00
0.08 152.00
0.00 0.00
0.00 0.00
0.07 162.00
```

b) Create two distinct variables containing the numerical values of the two columns of the data file loaded in part (a). The first vector should contain all elements of column 1 and should be labeled "density". The second vector contains the values of speed and should be labeled "speed".

### Task 2

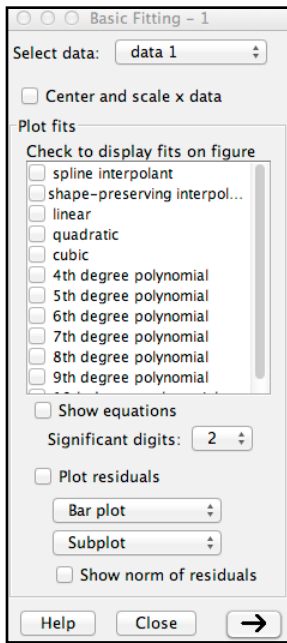
Enhance the script of Task 1. Using the "hist" command in Matlab, plot a histogram of the speeds observed on the Autobahn. Label your axes and headings accordingly. Comment on the shape of the speed distribution of the data. Is there a central tendency?

### Task 3

Enhance the script of Task 2 to calculate the mean and standard deviation of speeds observed in the Autobahn using the Matlab commands "mean" and "std", respectively. Output the values of the mean and standard deviation to the command window using the Matlab "disp" command. Comment on the results obtained.

### Task 4

Enhance the script of Task 3. Plot the speed (y-axis) values vs. the density of the traffic flow (x-axis). After the plot is created and with the plot window open, use the "Basic Fitting" feature of Matlab found under the "Tools" pull-down menu to find a regression equation (try first and second order polynomials) that relates density and speed. The "Basic Fitting" menu is shown in the figure below.



## Problem 4

The ACME company makes \$1600 for every metric ton of concrete mix of type A delivered. The company makes \$1735 for every metric ton of concrete mix of type B delivered. After formulating this optimization problem to maximize the revenue for the ACME company we found the following first Table (see Table 1) in the Simplex Method (see Homework 3 solution for more information if needed).

Let  $x_1 =$  be the amount produced of type A  
 $x_2 =$  be the amount produced of type B

$$Z - 1600x_1 - 1735x_2 = 0$$

$$-3/4x_1 + x_2 + x_3 = 500$$

$$2/3x_1 + x_2 + x_4 = 1,067$$

$$3x_1 + x_2 + x_5 = 2700$$

**Table 1.** Initial Table of the Problem. Current Solution is:  $x_1, x_2, x_3, x_4, x_5 = [0 \ 0 \ 500 \ 1067 \ 2700]$ . Basic variables are  $x_3, x_4, x_5$ . Non-basic variables (i.e., those that are zero in the solution) are  $x_1, x_2$ .

Basic Variable	Z	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$	RHS
	1	-1600	-1735	0	0	0	0
$x_3$	0	-3/4	1	1	0	0	500
$x_4$	0	2/3	1	0	1	0	1067
$x_5$	0	3	1	0	0	1	2700

### Task 1

Write down a matrix A in Matlab containing the numerical values found in the first Table to solve the optimization problem. Include the values of the RHS in the matrix A.

### Task 2

Use Matlab and perform row operations to solve this optimization problem. In other words, using the matrix created in Task 1 and the rules of the Simplex Method, perform row iterations on the matrix A to reach an optimal solution. For every new table found, write down the numerical values of the modified matrix A. You can verify the solution posted for Assignment 3.