

Assignment 7: Matlab Input and Output

Date Due: March 26, 2012

Instructor: Trani

Problem 1

The tallest structures in the World are shown in Table 1 as part of an Excel file to be used in this example.

Table 1. Tallest Structures in the World. Source: Wikipedia (2015).

Type of Structure	Name	Country	City	Height (m)	Height (ft)	Year
Skyscraper	Burj Khalifa	United Arab Emirates	Dubai	829.8	2722.0	2010
Self-supporting tower	Tokyo Skytree	Japan	Tokyo	634.0	2080.0	2011
Guyed mast	KVLY-TV mast	United States	Blanchard, North Dakota	628.8	2063.0	1963
Clock building	Abraj Al Bait Towers	Saudi Arabia	Mecca	601.0	1972.0	2011
Mast radiator	Lualualei VLF transmitter	United States	Lualualei, Hawaii	458.0	1503.0	1972
Twin towers	Petronas Twin Towers	Malaysia	Kuala Lumpur	452.0	1482.0	1998
Chimney	Ekibastuz GRES-2 Power Station	Kazakhstan	Ekibastuz	419.7	1377.0	1987
Radar	Dimona Radar Facility	Israel	Dimona	400.0	1312.0	2008

Task 1

Create a Matlab script to read the data. Use the Matlab “xlsread” command in Matlab to accomplish this. The script should also rename the variables according to the names shown in the header of the Excel file. For example, the first column should be converted into a variable called “TypeOfStructure” and so on.

Task 2

Modify the Matlab script created in Task 2 to find the structures taller than 300 meters. For this solution employ a pointer or index variable as explained in class. In your script create a new variable that contains the names of found structures. Find the average height (in both feet and meters) for this group of tall structures. Write to the command window the answer using the “disp” command in Matlab. In your solution display (i.e., include a screen capture) the names of the structures in the command window so that we know which structures were produced by your code.

Task 3

Modify the Matlab script created in Task 2 to find the structures build after the year 1990. Create a variable that contains the names of these structures and count the number of aircraft in this group. Find the average height of the structures found. In your solution display (i.e., include screen capture) the names of the structures in the command window so that we know which structures were produced by your code.

Task 4

Modify the Matlab script created in Task 3 to identify the tall structures in the United States. Create a new variable with the structures built in the US. In your solution display (i.e., include screen capture) the names of the structures in the command window so that we know which structures were produced by your code.

Problem 2

This problem deals with a beam supported at both ends and with a single load W at a known location. The beam is shown in Figure 1.

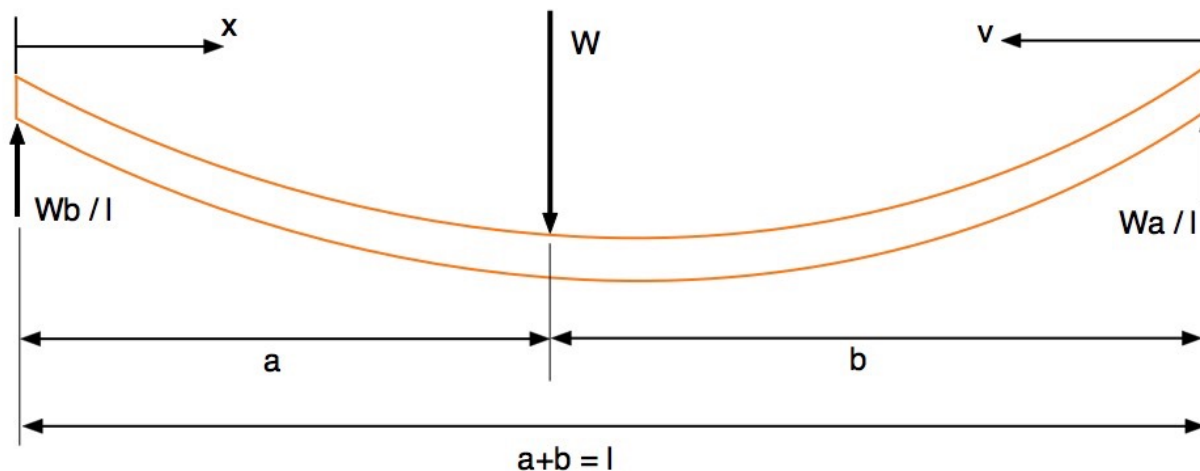


Figure 1. A simple beam supported at both ends with a load W at some known location. Adapted from: http://www.engineersedge.com/beam_bending/beam_bending3.htm.

Nomenclature for beam deflection and stress calculation equations.

W = load (N)

E = Modulus of elasticity (N/m^2)

I = Moment of inertia (m^4)

x = Distance from left side of the beam to the loading point (m)

v = Distance from right hand side beam end point to the loading point (m)

l = beam length (m)

a, b = distances from each beam end point towards the loading point (m)

Let:

$$y_a = \frac{-Wbx}{6EI}(l^2 - x^2 - b^2)$$

$$y_b = \frac{-Wav}{6EI}(l^2 - v^2 - a^2)$$

where:

y_a = deflection of the beam from left datum point (section a) in meters

y_b = deflection of the beam from right hand side datum point (section b) in meters

Task 1

Create a Matlab script to estimate the deflections of the beam (y_a and y_b) as a function of known quantities W , E , I , l , a , and b . Your script should define parameters: W , E , I , l , a and b . The output of the Matlab script consists of the values of beam deflections (y_a and y_b) and their stations (values of x and v).

Task 2

Test your Matlab script using the following values for the beam model parameters. Assume a steel beam is 8 meters long and has the following parameters.

$$W = 6000 \text{ N}$$

$$E = 200 \times 10^9 \text{ N/m}^2$$

$$I = 0.001 \text{ m}^4$$

$$l = 8 \text{ meters}$$

$$a = 3 \text{ meters}$$

$$b = 5 \text{ meters}$$

Task 3

Plot the results of the beam deflections as a continuous distance (from the left datum of the beam) and verify that the deflections make sense. Note that I added a negative sign to the deflection equations to show the deflections downwards.

Problem 3

The population data file included in this homework contains population data for more than 3000 counties in the US. The data file is found in the Syllabus page (week 2) and names "US Population". The file data is organized in column format as shown in Table 2. Note that each column with data represents a year.

Table 2. United States County Population Data.

TOTAL POPULATION (IN THOUSANDS)	1970	1975	1980	1985	1990	1995	1996
NAME							
AUTAUGA, AL	24.659	29.619	32.216	32.248	34.353	39.112	40.207
BALDWIN, AL	59.526	67.812	78.949	89.402	98.955	120.896	125.412
BARBOUR, AL	22.642	24.864	24.739	25.001	25.505	27.854	28.298
BIBB, AL	13.823	14.751	15.745	16.157	16.697	18.507	18.885
BLOUNT, AL	27.04	32.138	36.536	37.416	39.473	44.06	45.344
BULLOCK, AL	11.734	11.112	10.599	10.778	11.032	11.431	11.574
BUTLER, AL	21.964	21.195	21.772	22.425	21.886	21.824	21.863
CALHOUN, AL	103.185	108.245	120.025	118.648	116.118	116.79	116.684
CHAMBERS, AL	36.333	37.506	39.228	38.613	36.884	37.179	36.907
CHEROKEE, AL	15.781	18.11	18.888	18.891	19.643	21.871	22.387

Task 1

Use the Matlab import wizard to import the data contained in the file. Create a variable for each column during the import procedure. Save all the variables created and contained in workspace using the "save" command in Matlab (i.e., to a Matlab binary file).

Task 2

Create a script in Matlab that read the data saved in Task 1. Identify counties in the US that had more than 300,000 people in population in the year 2010. Use and index or pointer variable to do this. Create new variable to store the names of the counties that meet the criteria.

Task 3

Add code to the script created in Task 2 to plot a histogram of the distribution of the logarithm (ln) of the county population in the US for counties that had more than 300,000 people in the year 2010. Define a new variable in your script to estimate the natural logarithm of population. A histogram has the frequency of counties found for each bin in the y-axis and the logarithm of the county population in the x-axis.

Task 4

Enhance the script of Task 3. Calculate the rate of growth (in percent) for all US counties between years 1990 and 2010. Create a new variable to identify the counties that experienced a negative growth in the country between 1990 and 2010. Output the names of the counties found using the "xlswrite" command in Matlab. In your answer show a portion (i.e., screen capture) of the Excel file produced.

Problem 4

The airline data file included in this homework contains data for two airlines that are in the process of merging. The comma-separated file is reproduced below.

Table 1. Comma-separated data file with airline data.

```
Airline Name,Manufacturer,Aircraft Type,Engine Type,Age (years),Flight Hours (hrs)
Star Airlines,Boeing,737-800,CFM56-7B26,15,52610
Star Airlines,Boeing,737-800,CFM56-7B26,15,50926
Star Airlines,Boeing,737-800,CFM56-7B26,15,50436
Star Airlines,Boeing,737-800,CFM56-7B26,15,52076
Star Airlines,Boeing,737-800,CFM56-7B26,15,51584
Star Airlines,Boeing,737-800,CFM56-7B26,15,48869
Star Airlines,Boeing,737-800,CFM56-7B26,15,48987
```

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 %s %s %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 age of each aircraft in the data of the type “DC-9-83 (MD-83)”. Create a variable in your script to also calculate the average age of of this type of aircraft.

Task 4

Modify the Matlab script created in Task 3 to find the aircraft with more than 50,000 flight hours. Find the average age for the aircraft found.