Assignment 7: Matlab Input and Output

Date Due: April 6, 2020 Instructor: Trani

Problem 1

Table 1 contains all dams in the United States. The table is taken from a file called US_dams_clean.xlsx included as part of the assignment.

Table 1. United States Dams. Source: National Transportation Atlas (2018). The Second View of this Figure Shows the Nomenclature of the Data Tab.

Name	DamID	Longitude	Latitude	County	Height	Max Storae	Normal Storage	Surface Area	Drain Area	Hazard	State	Year
BRONCE	PR00027	-66.5616	18.0173	PONCE	52	843	620	0	0	S	PR	1939
COAMO	PR00016	-66.3844	18.0179	COAMO	65	1280	0	145	66	H	PR	1914
PATILLAS	PR00023	-66.021	18.021	PATILLAS	147	13797	11029	367	25	H	PR	1914
LOCO	PR00004	-66.8863	18.0446	YAUCO	74	2059	1039	69	8	H	PR	1951
ANA MARIA 5	PR00031	-66.5616	18.0583	PONCE	53	2382	1927	79	0	H	PR	1939
PORTUGUES	PR82202	-66.635	18.07	NONE	274	32000	16841	230	10	H	PR	9999
CARITE	PR00021	-66.1066	18.0782	GUAYAMA	104	14992	8953	333	8	H	PR	1913
ANTONIO LUCCHETTI	PR00003	-66.865	18.0831	YAUCO	175	17595	11575	266	17	H	PR	1952
GUAYABAL	PR00013	-66.5033	18.0888	JUANA DIAZ	130	5933	4768	373	21	H	PR	1913
TOA VACA DAM	PR00014	-66.485	18.1033	VILLALBA	215	54875	50620	836	22	H	PR	1972

Name	Name of dam
DamID	ID
Longitude	degrees (decimal)
Latitude	degrees (decimal)
County	US county
Height	feet
Max Storage	acre-feet
Normal Storage	acre-feet
Surface Area	acres
Drain Area	square miles
Hazard	
L	Low - no probable loss of human life and low economic and/or environmental loss
S	Significant - no probable loss of human life but can cause economic loss, environmental damage
H	High - failure or misoperation will probably cause loss of human life
U	Unknown - he potential hazard is unknown
State	US state
Year	Year built. 9999 means unknown.

Task 1

Create a Matlab script to read the data. Use any suitable Matlab import command(s) (i.e., **xlsread**, **textread**, **import wizard**, etc.) to accomplish the task. The script should include renaming variables according to the names shown in the header of the Excel file.

Task 2

Modify the Matlab script created in Task 1 to find the dams with Normal Storage capacity greater than 50,000 acre-feet . 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 the dams found. Find the mean Normal Storage for this group of dams. Write the answer to the command window using the **"disp"** command in Matlab. In your solution display (i.e., include a screen capture) the names of the first 15 dams found in this group in the command window so that we know which structures were produced by your code.

Task 3

Add another section of code to your Matlab script created in Task 2 to find the dams build after the years 1945. Create a variable that contains the names of the dams and count the number of dams in this group using the **"length"** command. Find the average height of the dams found. In your solution display (i.e., include screen capture) the names of the first 15 dams found, in the command window so that we know which structures were produced by your code.

Task 4

Add a section of code to the Matlab script created in Task 3 to create two plots: 1) a histogram of Height of all US dams and 2) a regular scattered plot with the dam Height in the x axis and the Normal Storage in the y axis. Comment on the trends observed.

Problem 2

This problem uses expands the analysis performed in Problem 1.

Task 1

Create a Matlab script that, after reading the dam data (similar to Problem 1), creates a histogram of the years of construction of the US dams. By inspection, find the period of time when more dams where built in the country.

Task 2

Add to the script created in Task 1 code to read a US map coastline (US_coastline.xlsx). This file contains latitude and longitude coordinates of the continental US (see Table 2). Plot the US coastline and also plot the locations of the US dams in the same map. You can use the "hold on" function in Matlab to keep a plot active to plot multiple data sets. Some dams are in Puerto Rico, Hawaii and Alaska so they will show up at locations outsize the US Continental map. Zoom in just on the continental area and make a screen capture to include in your solution. Label de dams using blue circles with marker size 7. This last operation can be done outside the Matlab script if needed.

Table 2. United States Coastline File. File Contains Latitude and Longitude Points of the US Coast.

1	Latitude_deg	Longitude_deg
2	25.97	-97.13
3	25.95	-97.22
4	25.97	-97.27
5	25.93	-97.28
6	25.93	-97.33
7	25.92	-97.35
8	25.85	-97.35
9	25.83	-97.37
10	25.87	-97.4

Task 3

Add to the script created in Task 2 code to create a **separate plot** with the locations of the US dams with "High" hazard level (level H in the Excel data). This plot should have the US map as well. Label de high hazard level dams using red circles with marker size 10. This last operation can be done outside the Matlab script if needed. Comment on the locations of the dams with hazard level H.

Problem 3

This problem uses the equations of a beam subject to a single load (W) as shown in Figure 1.

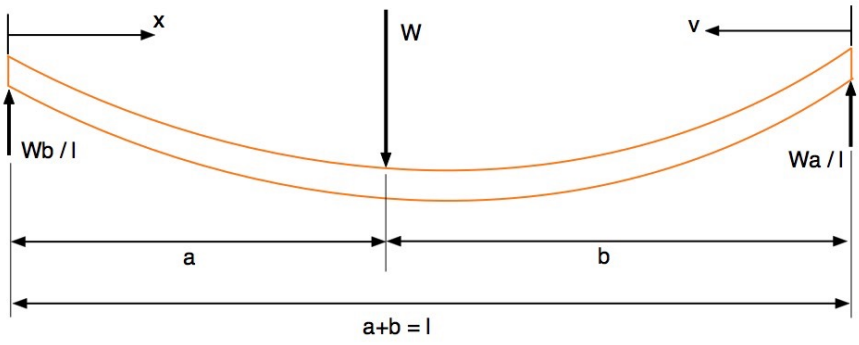

Figure 1. A simple beam supported at both ends with a load W at some known location. Adapted from: http://www.engineersedge.com/beam_bending/beam_bending3.htm. The nomenclature for beam deflection equations are shown below.

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:

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

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

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 **function** to estimate the deflection of the beam (y_a). The function should accept as input variables the values of W, E, I, l, b and x. The output of the Matlab function is the value of beam deflection (y_a) for the given station (x). Your function should either a scalar value of x or a a vector x to do calculations.

Test your Matlab function using the following values for the beam model parameters shown below. Clearly state the values of the deflections at the values of beam station (x) shown below.

W = 6000 N
E = 200e9 N/m-m
I = 0.001 m^4
l = 6.5 meters
b = 3.5 meters
a = 3.0 meters
x = 0, 1, 1.5 and 2.5 meters.

Find the deflection of the beam for values of x ranging from 0 to b at intervals of 0.1 meters.

Task 2

Create a **Matlab script** that uses the function created in Task 1 to estimate the beam deflection (y_a) for values of x ranging from 0 to 3 meters at intervals of 0.1 meters. In the calculations for Task 2 define x as a vector to see if your function is able to produce a vector for (y_a) . Make a plot of the beam deflection (y_a) as a function of beam station (x). Comment on the observed trend.

Task 3

Create a **Matlab function** to estimate the beam reaction forces at the two support points. The function should accept as input variables the values of W, l, b and a to produce two outputs (i.e., two reaction forces).

Problem 4

A file containing Amtrak stations is included with this assignment (Amtrak_stations_xlslx). A sample of the data included is shown in Table 2.

Table 2. United States Amtrak Stations.

	A	B	C	D	E	F
1	Longitude_deg	Latitude_deg	Station_Code	County	State	Station_Type
2	-82.440842	38.415405	HUN	Huntington	WV	RAIL
3	-97.930061	38.055859	HUT	Hutchinson	KS	RAIL
4	-85.469925	43.395729	HWC	Howard City	MI	BUS
5	-116.23317	33.714752	IDO	Indio	CA	BUS
6	-94.429298	39.086975	IDP	Independence	MO	RAIL
7	-86.160309	39.762154	IND	Indianapolis	IN	RAIL
8	-117.759193	33.674767	IRV	Irvine	CA	RAIL
9	-90.190598	32.300644	JAN	Jackson	MS	RAIL

Task 1

Create a Matlab script to read the data. Use any suitable Matlab import command(s) (i.e., **xlsread**, **textread**, **import wizard**, etc.) to accomplish the task. The script should include renaming variables according to the names shown in the header of the Excel file (see Table 2).

Task 2

Add to the script created in Task 1 to filter rail stations only. The original file provided by Amtrak has bus, ferry and other stations. Plot the RAIL stations and superimpose them on the US map supplied with the assignment.

Task 3

Add code to the script created in Task 2 to identify the rail stations in the state of Virginia and create a new plot using Matlab.