Assignment 7: Matlab Input/ Output and Functions

Date Due: March 26 , 2021 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
2	BRONCE	PR00027	-66.5616	18.0173	PONCE	52	843	620	0	0	S	PR	1939
3	COAMO	PR00016	-66.3844	18.0179	COAMO	65	1280	0	145	66	H	PR	1914
4	PATILLAS	PR00023	-66.021	18.021	PATILLAS	147	13797	11029	367	25	H	PR	1914
5	LOCO	PR00004	-66.8863	18.0446	YAUCO	74	2059	1039	69	8	H	PR	1951
6	ANA MARIA 5	PR00031	-66.5616	18.0583	PONCE	53	2382	1927	79	0	H	PR	1939
7	PORTUGUES	PR82202	-66.635	18.07	NONE	274	32000	16841	230	10	H	PR	9999
8	CARITE	PR00021	-66.1066	18.0782	GUAYAMA	104	14992	8953	333	8	H	PR	1913
9	ANTONIO LUCCHETTI	PR00003	-66.865	18.0831	YAUCO	175	17595	11575	266	17	H	PR	1952
10	GUAYABAL	PR00013	-66.5033	18.0888	JUANA DIAZ	130	5933	4768	373	21	H	PR	1913
11	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 that pose a High Hazard level. In your script create a new variable that contains the names of the dams found. Find the mean Surface Area 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 20 dams found in this group in the command window.

Task 3

Add another section of code to your Matlab script created in Task 2 to find the dams build before the year 1900. Create a variable that contains the names of the dams and count the number of dams in this group. Find the average height of the dams found. In your solution display (i.e., include screen capture) the names of the first 10 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 to plot: 1) a histogram of the maximum storage of the US dams and 2) a regular scattered plot with the dam height in the x axis and the maximum storage in the y axis. Comment on the trends observed.

Problem 2

Designing airport runways is a task for Civil Engineers. A file with forty eight thousand landings at LaGuardia International Airport in New York is provided for this analysis. A brief sample of the data is shown below.

A	B	C	D	E	F	G	H
Airport	Flight ID	Aircraft	Touchdown Distance (ft)	ROT Fuselage (s)	Exit Distance (ft)	Threshold Crossing Speed (kts)	Exit Speed (kts)
LGA	VNX98	SR22	390.5	39.1	2729.0	71.7	18.8
LGA	N614LD	PC12	443.3	55.4	3780.2	82.0	21.0
LGA	N858W	BE58	456.2	55.6	3786.1	89.1	17.7
LGA	CNS728	PC12	461.7	35.9	2726.3	84.5	20.7
LGA	N41173	PA31	477.6	38.2	2725.2	73.5	19.9
LGA	HPK12	SR22	477.9	60.0	3782.9	76.8	14.2
LGA	N614LD	PC12	497.2	53.2	3778.8	81.0	21.8
LGA	N324BR	SR22	498.0	54.8	3783.7	74.5	23.0
LGA	N858W	BE58	504.2	52.6	3995.5	88.5	20.5
LGA	N98SL	SR22	509.5	42.6	3800.0	93.3	24.7
LGA	CNS55	PC12	512.2	46.4	3997.5	92.2	23.0
LGA	IMG736	SR22	513.6	53.4	3776.5	82.7	12.6
LGA	IMG736	SR22	513.6	51.4	3991.5	83.9	20.6
LGA	N8851K	C310	513.6	46.8	3743.7	95.1	14.6
LGA	CNS229	PC12	515.9	47.1	3739.6	88.1	16.5
LGA	N232BG	BE9L	516.8	41.0	2730.2	91.3	15.9

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. You are allowed to let Matlab create the script to read the data as well.

Task 2

Create Matlab code to add a histogram of the touchdown distance for Boeing 737-800 aircraft (aircraft label B738). Label the histogram appropriately. Your histogram should have 20 bins. Find the most repeated value of touchdown distance for the set.

Task 3

Add to the Matlab script more code to create a cumulative density function - CDF (hint: use the cdfplot function in Matlab) of the runway occupancy time (ROT) for the Boeing 737-800 (aircraft label B738). Label the CDF plot appropriately. According to the SAS Institute: "*the CDF plot is used to determine the percent of data that is at or below a given value on the horizontal axis".* Examine the CDF plot and estimate the ROT value at 0.5 value (called the median).

Task 4

Add to the Matlab script more code to create a scatter plot with the exit distance (x-axis) versus ROT (y-axis) for all aircraft in the data. Label the scatter plot appropriately.

Use the Basic Fitting panel in Matlab to find the best equation of a linear regression line that fits the data points. Comment on the dispersion (i.e., spread) of ROT data. Is there are pattern?

Task 5

Add to the Matlab script more code to estimate the percent of landings for aircraft of type A320 with runway threshold crossing speeds below 125 knots.

Problem 3

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 in California (with red dots) and Virginia (with blue dots) 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 New York and plot the locations of the New York stations in the same maps as before (use green triangles).

Task 4

Find the number of bus stations contained in the Amtrak station file. Find the unique states where those stations are located. Matlab provides a handy unique command.

Problem 4

A formula to estimate the noise generated by a train is found to be:

Leq = SELref + 10 log(Ncars) + 20 log(S/50) + 10 log (V) – 31.6

where:

Leq = equivalent noise level (decibels - dBA)

SEL ref = reference sound exposure level (decibels - dBA)

Ncars = number of cars in the train

S = train speed (mph)

V = hourly average train volume (trains per hour)

log = natural log of the number

Task 1

Write a **Matlab function (not a script)** to calculate the value of Leq given parameters: S (speed), SELref (sound exposure level), Ncars (train cars), and hourly train volume (V). The values of S, SELref, Ncars and V are input arguments of the function. The function returns the value of Leq. Write the function so that it can accept vectors of values for S, Ncars or V.

Task 2

Write a Matlab script to calculate the values of Leq for a train with 6 cars, the hourly train volume is 25 trains/hr, Sref is 55, and the train speed ranges from 20 to 65 mph. The values of V, Ncars, Sref and S are defined in the Matlab script. The function created in Task 1 is used by the Main script.

Task 3

Add more code to the Matlab script created in Task 2 to plot the values of Leq as a function of train speed. Label the plot appropriately.