Assignment 6: Basic Matlab Operations

Due Date: March 27, 2026

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Problem 1

Use Matlab to solve the problem.

A common problem in Civil Engineering is to estimate the deflection of a double supported beam at different stations (see Figure 1).

$$y = \frac{W}{24EI}(-x^4 + 2Lx^3 - L^3x) \quad \text{(Equation 1)}$$

where:

y is the deflection at any point in the beam (meters)

x is the distance from the left-hand side of the beam to any point on the beam (meters)

W is the load applied load (N/m)

l is the length of the beam (meters)

E is the modulus of elasticity (N/m^2)

I is the moment of inertia (m^4)

The units in this model are all consistent.

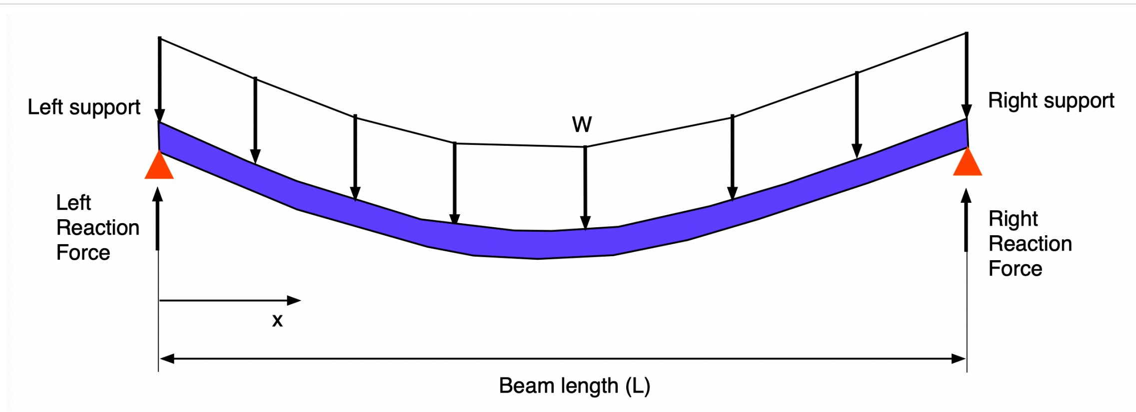

Figure 1. Double Supported Beam Subject to a Uniform Load (W).

a) Create a Matlab script to estimate the estimate the beam deflection (*y*) given the parameters on the right hand side of Equation 1.

Evaluate the deflection by creating 1,000 equally-spaced stations (x) along the beam length. The values of the parameters are:

W = 3000 N/m.

l =6 meters

E = 2.00e9 (N/m^2) - steel beam

I = 0.001(m^4)

b) Plot the deflection (*y*) as a function of the beam station (*x*).

c) Using the Matlab **max(y)** command, find the maximum deflection of the beam.

d) Modify the script created in part (A) creating another variable z where z is defined as:

$$z = gradient(y)$$

The function gradient takes the first derivative of the values of vector (y) - the slope of the deflection.

Using the “subplot” command create a new figure with two plots. Plot the values of x vs. y in the upper part of the window and x vs. in the lower part of the same window. Change the line colors to distinguish the two views.

e) Verify that the “gradient” function is working by inspecting the slope of the beam deflection at the maximum deflection point.

Problem 2

Use the **Airport_data.xlsx** file to work on the problem. For each problem show the Matlab code used to execute the task.

Airport ID	Name	State	Air Carrier Passengers	Commuter Passengers	Latitude (deg)	Longitude (deg)
00V	MEADOW LAKE	CO	0	0	38.9457	104.5699
01G	PERRY-WARSAW	NY	0	0	42.7413	78.0521
02A	GRAGG-WADE FIELD	AL	0	0	32.8505	86.6114
02C	CAPITOL	WI	0	0	43.0875	88.1779
02G	COLUMBIANA COUNTY	OH	0	0	40.6733	80.6414
04Y	HAWLEY MUNI	MN	0	0	46.8838	96.3503
05C	GRIFFITH-MERRILLVILLE	IN	0	0	41.5198	87.3995
05U	EUREKA	NV	0	0	39.6042	116.0051
06A	MOTON FIELD MUNI	AL	0	0	32.4605	85.6800
06C	SCHAUMBURG REGIONAL	IL	0	0	41.9893	88.1012
06D	ROLLA MUNI	ND	0	0	48.8843	99.6209
06N	RANDALL	NY	0	0	41.4320	74.3916

Figure 2. U.S. Airports.

a) Use the Matlab import wizard to read the all data. Let **Matlab create the code** to read the data. Save the file and provide a screen capture of the first 15 lines of code.
b) Create individual variables for each column of data provided. Label the variables according to the headers in the Excel file.
c) Plot the longitude of the airport (x-axis) versus the latitude of the airport location (y-axis) to get an idea of the locations of the airports in the US.
d) Use the string comparison command (strcmp) to find the airports in the state of Virginia. Create a variable with the names of the airports in Virginia. Show me the name of the first 15 airports listed in your answer.
e) Add to the script in part (e) to find the number of airports in California.
f) Add another piece of Matlab code to create an index variable (pointer) for airports with more than 10,000 passengers (the sum of commuter and air carrier passengers). Show me the names (via a screen capture) of the first 15 airports that make your list.
g) Find the airports in Texas with more than 100,000 total passengers.

Problem 3

Use the GPS data collected by a car data logger to do this problem. A sample of the data is shown below.

```
% GPS car data collected in rural roads in Arizona
% Car = Toyota Corolla (1992)

% Column 1 = Time of observation (seconds)
% Column 2 = Distance traveled (m)
% Column 3 = Speed (km/hr)
% Column 4 = Acceleration (m/s-s)


0       0.0             0.0             0.0
2       23.0    41.4    0.54
4       52.0    52.1    1.48
6       82.9    55.6    0.49
8       115.6   58.9    0.46
10      149.3   60.8    0.26
```

Figure 2. Car Speed Data. Available on Week of the Weekly Planner.

a) Read the data using Matlab.

b) Plot the car speed in meters/second (in y-axis) vs. time (x- axis) in seconds. Observe the plot and comment on the number of stops in the profile.

c) Convert the speed data into units of miles per hour and create a new variable.

d) Estimate the acceleration of the car as a function of time using the metric data. Use the Matlab "gradient(x)" function to find the acceleration using the speed vector created in part (c). Plot the calculated acceleration vs. time recorded by the GPS data logger unit.

e) Use the Max(x) command in Matlab to detect the largest speed during the journey. Find the time when the maximum speed is recorded. Display the maximum speed and the time in the Command window (use the DISP command).

f) Find the average speed in meters per second of the car when the car is in motion. Use the Matlab function MEAN(x) to get the average speed for all values.

g) Find the number of seconds the car is stopped at intersections. Use the Matlab FIND function to do this part.