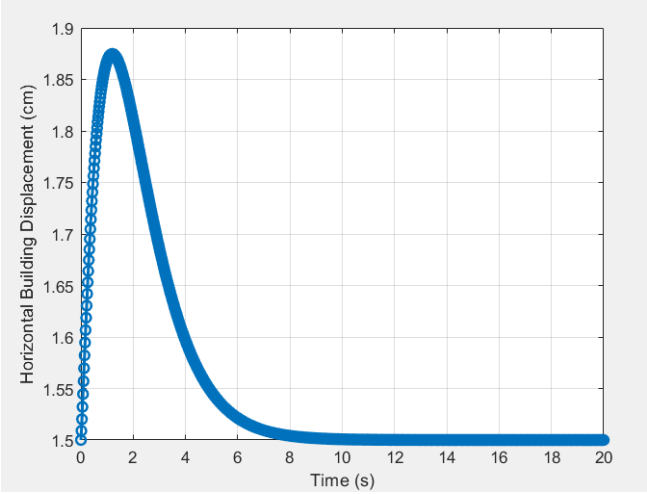
CEE 3804 Assignment 7 Solution

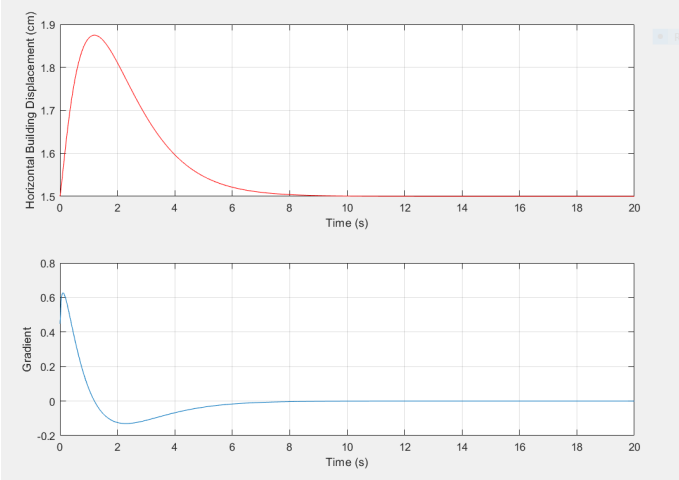
Problem 1

a) and b)

```
%% Problem 1 a)
t=0:0.02:20;
y=1.5+t.^(1.2).*exp(-t);
ha=plot(t,y);
grid on
xlabel('Time (s)')
ylabel('Horizontal Building Displacement (cm)')
%% Problem 1 b)
ha.LineWidth=1.5;
ha.Marker='o';
ha.Color=[0 0.4470 0.7410];
```



c)



```
%% Problem 1 c)
z=gradient(y,0.02);
subplot(2,1,1)
hc1=plot(t,y);
hc1.Color='b';
xlabel('Time (s)')
ylabel('Horizontal Building Displacement (cm)')
grid on
subplot(2,1,2)
hc2=plot(t,z);
hc1.Color='r';
grid on
xlabel('Time (s)')
ylabel('Gradient')
```

d) and e)

Peak: y= 1.8749 z= 3.4709e-05 (very close to zero)

The time when it happens t=1.20 seconds

```
%% Problem 1 d) and e)
[max_disp,index]=max(y);
z_at_peak=z(index);
time_max_disp=t(index);
```

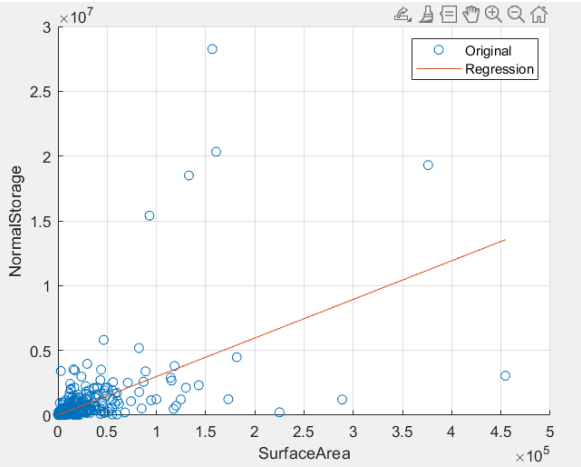
Problem 2

a) and b)

```
%% Problem 2 a) and b)
warning('off')
USdam=readtable('C:\CEE 3804\HW7\US_dams_2023.xlsx','Sheet','damData');
```

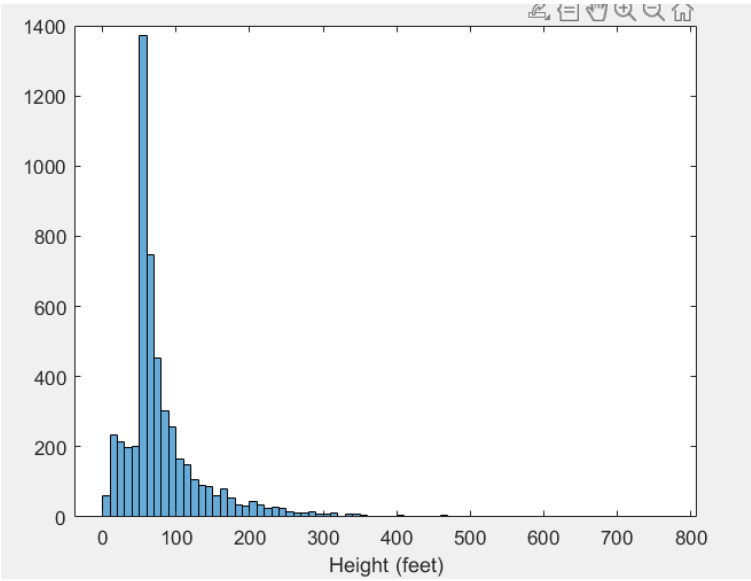
c) and d)

Regression y= 29.796*x+2432.4 R^2=0.362



```
%% Problem 2 c) and d)
h1=scatter(USdam.SurfaceArea,USdam.NormalStorage);
grid on
hold on
xlabel('SurfaceArea')
ylabel('NormalStorage')
mdl=fitlm(USdam.SurfaceArea,USdam.NormalStorage);
NormalStorage_prediction=predict(mdl,USdam.SurfaceArea);
h2=plot(USdam.SurfaceArea,NormalStorage_prediction);
legend([h1 h2],'Original','Regression')
```

e) The most frequent height of US dams is in the range between 50 ~ 60 feet.



f)

	1
1	SENATOR WASH - SQUAW LAKE DIKE
2	SAVAGE
3	UPPER OTAY
4	WUEST
5	BARRETT
6	MORENA
7	SWEETWATER MAIN
8	MURRAY
9	LOVELAND, LAKE
10	PALO VERDE
11	CHET HARRITT
12	EL CAPITAN
13	IMPERIAL DIVERSION
14	SENATOR WASH
15	SAN VICENTE
16	CUYAMACA
17	POWAY
18	RAMONA
19	SAN DIEGUITO
20	HODGES, LAKE

g) The number of dams in the state of Virginia: 130

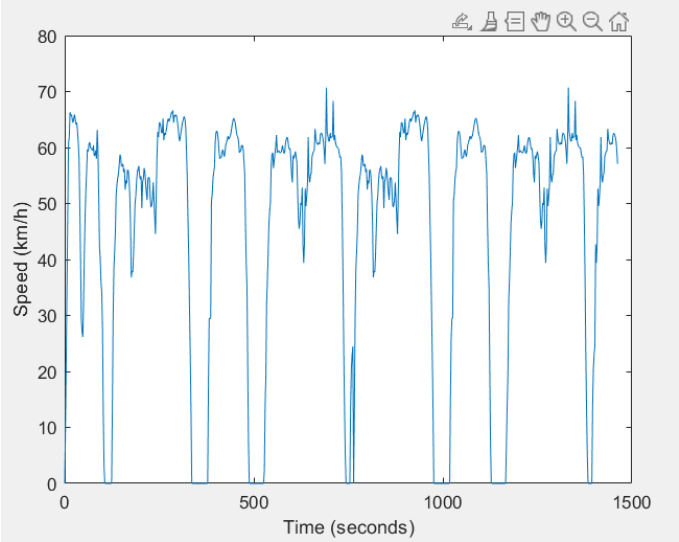
```
%% Problem 2 e)
histogram(USdam.Height)
xlabel('Height (feet)')
%% Problem 2 f)
Dam_CA=USdam.Name(strcmp(USdam.State,'CA'));
%% Problem 2 g)
Num_Dam_VA=sum(strcmp(USdam.State,'VA'));
```

Problem 3

a) and b)

There are 8 stops.

```
%% Problem 3 a) and b)
warning('off')
GPSData=readtable('C:\CEE 3804\HW7\GPSData_a7_blank.xls','Sheet','GPS Car Data');
plot(GPSData.Time_s_,GPSData.Speed_km_h_)
xlabel('Time (seconds)')
ylabel('Speed (km/h)')
```

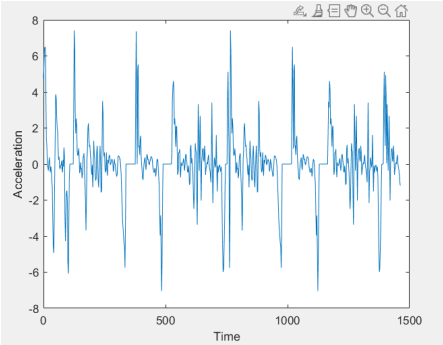


c) and d)

```
%% Problem 3 c) and d)
GPSData.Speed_meter_sec_=GPSData.Speed_km_h_*1000/3600;
GPSData.Speed_miles_h_=km2sm(GPSData.Speed_km_h_);
```

e)

```
%% Problem 3 e)
GPSData.Acceleration = gradient(GPSData.Speed_km_h_,2);
plot(GPSData.Time_s_,GPSData.Acceleration)
xlabel('Time')
ylabel('Acceleration')
```



f), g), and h)

The largest speed during the journey: 70.7 km/hr.

The time when the maximum speed is recorded are: 692 and 1332 seconds.

The average speed in miles per hour: 28.58 mph

The number of seconds the car is traveling below 15 mph: 284 seconds or 142 intervals, the vehicle is below 15 mph.

```
%% Problem 3 f), g), and h)
[max_speed,~]=max(GPSData.Speed_km_h_);
idx=find(GPSData.Speed_km_h_==max_speed);
time_max_speed=GPSData.Time_s_(idx);
disp(max_speed)
disp(time_max_speed)
average_speed_miles_hour=mean(GPSData.Speed_miles_h_);
num_seconds_less_15mph=length(find(GPSData.Speed_miles_h_<=15));
```

The num_seconds_less_15mph is really the number of instances that Matlab finds the speed below 15. However, the quantity needs to be multiplied by 2 because very time interval is 2 seconds.

Number of seconds below 15 mph = 284 seconds

Number of instances below 15 mph = 142

Problem 4

Task 1

$$3x_1 + 4x_2 + x_3 + 6x_4 = 25$$
$$2x_1 + 9x_2 + 7x_3 + 13x_4 = 36$$
$$6x_1 + 5x_2 + 3x_3 + x_4 = 21$$
$$3x_1 + 8x_2 + 9x_3 + 3x_4 = 13$$

Define the system of equations as:

A=[3 4 1 6; 2 9 7 13; 6 5 3 1; 3 8 9 3];

b=[25 36 21 13]'

The solution of the system of equations is:

X=A\b

x =

2.8446

1.0473

-1.1824

2.2432

The same result is obtained if we use the inverse function in Matlab.

x= inv(A)*b

Task 2

```
%% Problem 4 Task 2
C=[5 2 1 6;2 9 7 13;6 5 3 1;7 8 9 3];
D=[1 5 2 6]';
E=C*D;
det(C);
inv(C);
F = (C+25)/3;
G = diag(C);
S = inv(C)*D;
T = ones(4,4) + C;
first_row_C=C(1,:);
last_column_C=C(:,end);
```

a)

```
E =

    53
   139
    43
    83
```

b) 1.4840e+03

c)

```
  0.1509   -0.0802    0.0236    0.0377
 -0.2372    0.1260    0.3915   -0.2022
  0.0566   -0.0613   -0.3349    0.2642
  0.1105    0.0350   -0.0943   -0.0081
```

d) and e)

```
F =

   10.0000    9.0000    8.6667   10.3333
    9.0000   11.3333   10.6667   12.6667
   10.3333   10.0000    9.3333    8.6667
   10.6667   11.0000   11.3333    9.3333


G =

     5
     9
     3
     3
```

f) and g)

```
S =

    0.0236
   -0.0371
    0.6651
    0.0485


T =

     6     3     2     7
     3    10     8    14
     7     6     4     2
     8     9    10     4
```

h) and i)

```
first_row_C =

     5     2     1     6


last_column_C =

     6
    13
     1
     3
```