HOMEWORK 3

SOLUTIONS

2.* Let $x = -5 - 8i$ and $y = 10 - 5i$. Use MATLAB to compute the following expressions. Hand-check the answers.

a. The magnitude and angle of xy.

b. The magnitude and angle of $\frac{x}{y}$.

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_2.m

que_2.m

```
clc
clear all
x=-5-8i;
y=10-5i;
%magnitude of xy
magX=abs(x)
magY=abs(y)
magProd=abs(x*y)
%magnitude of x/y
magDiv=abs(x/y)
%angle of xy
angleX=angle(x)
angleY=angle(y)
angleXY=angleX+angleY
%angle of x/y
angDiv=angleX-angleY
```

Command Window

```
magProd =

  105.4751


magDiv =

    0.8438


angleXY =

   -2.5930


angDiv =

   -1.6657
```

3.* Use MATLAB to nd the angles corresponding to the following coordinates. Hand-check the answers.

a. $(x, y) = (5, 8)$ *b.* $(x, y) = (-5, 8)$

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_3.m

que_2.m | que_3.m

```
clc
clear all
%angle of (5,8)
a=atan2(8,5)
deg1=a*(180/pi)
%angle of (-5,8)
b=atan2(8,-5)
deg2=b*(180/pi)
```

Command Window

```
a =

    1.0122


deg1 =

   57.9946


b =

    2.1294


deg2 =

  122.0054
```

10.* An object thrown vertically with a speed v_0 reaches a height h at time t, where

$$h = v_0 t - \frac{1}{2} g t^2$$

Write and test a function that computes the time t required to reach a speci ed height h, for a given value of v_0. The function's inputs should be h, v_0, and g. Test your function for the case where $h = 100$ m, $v_0 = 50$ m/s, and $g = 9.81$ m/s^2. Interpret both answers.

Solution

Function file

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\time.m

que_2.m | que_3.m | time.m | fun.m | que_10.m | +

```
function [t]=time (h,v0,g)
%t=[((2*v0)+sqrt((-2*v0)^2-(4*g*2*h)))/(2*g),
    %((2*v0)-sqrt((-2*v0)^2-(4*g*2*h)))/(2*g)];
  t=[(v0+sqrt((-v0)^2-4*0.5*g*h))/(2*0.5*g),
      (v0-sqrt((-v0)^2-4*0.5*g*h))/(2*0.5*g)];

```

Main file

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_10.m

que_2.m | que_3.m | time.m | fun.m | que_10.m | +

```
clc
clear all
h=100;
v0=50;
g=9.81;
t=time(h,v0,g)

```

Command Window

```
t =

    7.4612
    2.7324

>>
```

12. A fence around a eld is shaped as shown in Figure P12. It consists of a rectangle of length L and width W, and a right triangle that is symmetrical about the central horizontal axis of the rectangle. Suppose the width W is known (in meters) and the enclosed area A is known (in square meters). Write a user-de ned function le with W and A as inputs. The outputs are the length L required so that the enclosed area is A and the total length of fence required. Test your function for the values $W = 6$ m and $A = 80$ m^2.

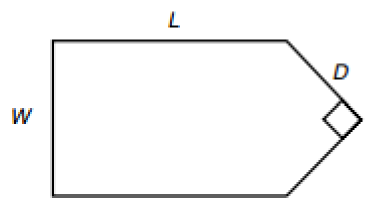


Figure P12

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\side.m

que_2.m | que_3.m | time.m | que_12.m | side.m | leng.m | totleng.m

```
% By Pythagorus theorem,W^2=D^2+D^2
function [D]=side(W)
D=sqrt(W^2/2);
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\leng.m

que_2.m | que_3.m | time.m | que_12.m | side.m | leng.m | totleng.m

```
function [L]=leng(W,A)
L=(A-((W^2/2)*1/2))/W;
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\totleng.m

que_2.m | que_3.m | time.m | que_12.m | side.m | leng.m | totleng.m

```
function [TL]=totleng(L,W,D)
TL=L+L+W+D+D;
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_12.m

que_2.m | que_3.m | time.m | que_12.m | side.m | leng.m | totleng.m

```
clc
clear all
W=6; A=80;
D=side(W)
L=leng(W,A)
disp('Length of rectangle:')
disp(L)
TL=totleng(L,W,D)
disp('Total length of fence:')
disp(TL)
```

Command Window

```
D =

    4.2426


L =

   11.8333

Length of rectangle:
   11.8333


TL =

   38.1519

Total length of fence:
   38.1519
```

14. Using estimates of rainfall, evaporation, and water consumption, the town engineer developed the following model of the water volume in the reservoir as a function of time

$$V(t) = 10^9 + 10^8(1 - e^{-t/100}) - rt$$

where V is the water volume in liters, t is time in days, and r is the town's consumption rate in liters per day. Write two user-de ned functions. The rst function should de ne the function $V(t)$ for use with the `fzero` function. The second function should use `fzero` to compute how long it will take for the water volume to decrease to x percent of its initial value of 10^9 L. The inputs to the second function should be x and r. Test your functions for the case where $x = 50$ percent and $r = 10^7$ L/day.

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\tdec.m

volchange.m | tdec.m | que_19.m | Prac2.m | prac1.m | que_20.m | que_14.m

```
function timevol=tdec(x,r)
timevol=fzero(@volchange,10)
```

_*

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\volchange.m

volchange.m | tdec.m | que_19.m | Prac2.m | prac1.m | que_20.m | que_14.m

```
%Vini-Initial volume
%Vini=10^9+(10^8*(1-exp(-t/100))-(r*t));
%x=50%
%Vfin=Final volume=(x/100)*Vini=(50/100)*Vini=0.5*10^9
%Vchange=Vfin-Vini=(0.5*10^9)-(10^9+(10^8*(1-exp(-t/100))-(r*t)))
function [Vchange]=volchange(t)
x=50, r=10^7;
V=10^9+(10^8*(1-exp(-t/100))-(r*t))
Vfin=(x/100)*(10^9)
Vchange= (Vfin-V)
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_14.m

volchange.m | tdec.m | que_19.m | Prac2.m | prac1.m | que_20.m | que_14.m

```
clc
clear all
x=50;r=10^7;
timevol=tdec(x,r)
```

Command Window

```
timevol =

   54.1832
```

17. Suppose it is known that the graph of the function $y = ax^3 + bx^2 + cx + d$ passes through four given points (x_i, y_i), $i = 1, 2, 3, 4$. Write a user-de ned function that accepts these four points as input and computes the coef cients a, b, c, and d. The function should solve four linear equations in terms of the four unknowns a, b, c, and d. Test your function for the case where $(x_i, y_i) = (-2, -20)$, $(0, 4)$, $(2, 68)$, and $(4, 508)$, whose answer is $a = 7$, $b = 5$, $c = -6$, and $d = 4$.

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\polcons.m

tdec.m | polcons.m | que_17.m | que_19.m | Prac2.m | prac1.m | que_20.m

```matlab
function [constants]= polcons(x1,y1,x2,y2,x3,y3,x4,y4)
X=[(x1^3),(x1^2),x1,1;
    (x2^3),(x2^2),x2,1;
    (x3^3),(x3^2),x3,1;
    (x4^3),(x4^2),x4,1]
Y=[y1;y2;y3;y4];
[constants]=X\Y;
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_17.m

tdec.m | polcons.m | que_17.m | que_19.m | Prac2.m | prac1.m | que_20.m

```matlab
clc
clear all
x1=-2;y1=-20;
x2=0;y2=4;
x3=2;y3=68;
x4=4;y4=508;
[constants]= polcons(x1,y1,x2,y2,x3,y3,x4,y4)
a=constants(1), b=constants(2),c=constants(3),d=constants(4)
```

Command Window

```
X =

    -8     4    -2     1
     0     0     0     1
     8     4     2     1
    64    16     4     1


constants =

     7
     5
    -6
     4
```

```
a =

     7


b =

     5


c =

    -6


d =

     4
```

19. Create an anonymous function for $20x^2 - 200x + 3$ and use it

a. To plot the function to determine the approximate location of its minimum

b. With the `fminbnd` function to precisely determine the location of the minimum

---

Solution

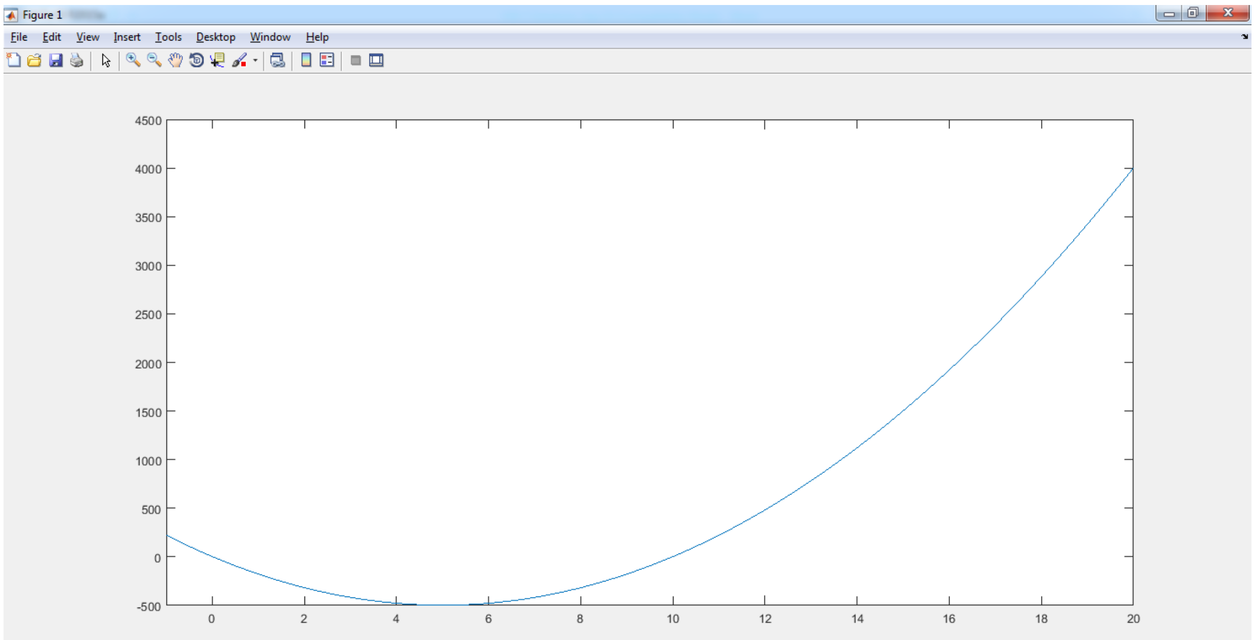
Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_19.m

```
clc
clear all
p=@(x) 20*x.^2-200*x+3;
% a.To find minimum from plot
x=[1:0.1:20]
plot(x,p(x))
%appropriate location minimum -1<x<6
z=fminbnd(p,-1,6)
% to find minimum of y
```

Command Window

```
z =

    5.0000
```



22. Create a primary function that uses a function handle with a nested function to compute the minimum of the function $20x^2 - 200x + 12$ over the range $0 \le x \le 10$.

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\parabol.m

vol.m | volchange.m | que_14.m | pol.m | parabol.m | que_22.m | que_19.m

```
function [pol1]= parabol(a,b,c)
pol1=@polfind;
% Nested Function
function y=polfind(x)
y=polyval([a,b,c],x);
end
end
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_22.m

vol.m | volchange.m | que_14.m | pol.m | parabol.m | que_22.m | que_19.m

```
clc
clear all
x=0:0.1:10;
a=20; b=-200; c=12;
pol1= parabol(a,b,c);
%y=polfind(x)
fminbnd(pol1,1,10)
```

Command Window

```
ans =

    5.0000
```

24. Enter and save the data given in Problem 23 in a spreadsheet. Then import the spreadsheet le into the MA TLAB variable A. Use MATLAB to compute the sum of each column.

<u>**Solution**</u>

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_24.m

volchange.m | que_14.m | pol.m | parabol.m | que_22.m | que_19.m | que_24.m

```
A=xlsread('que_24')
B=sum(A,1)
```

Command Window

```
>> que_24

A =

    55    42    98
    49    39    95
    63    51    92
    58    45    90


B =

   225   177   375
```

5. For several values of x, use MATLAB to con rm that $\cosh^{-1} x = \ln\left(x + \sqrt{x^2 - 1}\right), x \geq 1$

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_5.m

que_14.m | pol.m | parabol.m | que_22.m | que_19.m | que_24.m | que_5.m

```
clc
clear all
x=1:10;
b=acosh(x)
c=log(x+sqrt((x.^2)-1))
```

Command Window

```
b =

  Columns 1 through 8

         0    1.3170    1.7627    2.0634    2.2924    2.4779    2.6339    2.7687

  Columns 9 through 10

    2.8873    2.9932


c =

  Columns 1 through 8

         0    1.3170    1.7627    2.0634    2.2924    2.4779    2.6339    2.7687

  Columns 9 through 10

    2.8873    2.9932
```

6. The capacitance of two parallel conductors of length L and radius r, separated by a distance d in air, is given by

$$C = \frac{\pi \epsilon L}{\ln\left[(d - r)/r\right]}$$

where ϵ is the permittivity of air ($\epsilon = 8.854 \times 10^{-12}$ F/m).

Write a script le that accepts user input for d, L, and r and computes and displays C. Test the le with the values $L = 1$ m, $r = 0.001$ m, and $d = 0.004$ m.

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\capa.m

parabol.m | que_22.m | que_19.m | que_24.m | que_5.m | que_6.m | capa.m

```
function [capacitance]=capa(L,r,d,E)
capacitance=(pi*E*L)/(log((d-r)/r));
```

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_6.m

parabol.m | que_22.m | que_19.m | que_24.m | que_5.m | que_6.m | capa.m

```
clc
clear all
E=8.854*10^-12;
L=input('Enter the value of L:');
r=input('Enter the value of r:');
d=input('Enter the value of d:');
capacitance=capa(L,r,d,E)
```

Command Window

```
Enter the value of L:1
Enter the value of r:0.001
Enter the value of d:0.004

capacitance =

   2.5319e-11
```

13. A fenced enclosure consists of a rectangle of length L and width $2R$ and a semicircle of radius R, as shown in Figure P13. The enclosure is to be built to have an area A of 2000 ft^2. The cost of the fence is \$50 per foot for the curved portion and \$40 per foot for the straight sides. Use the `fminbnd` function to determine with a resolution of 0.01 ft the values of

R and L required to minimize the total cost of the fence. Also compute the minimum cost.

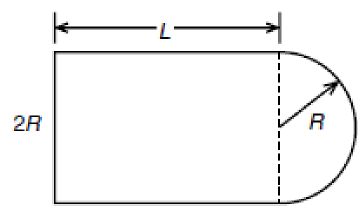


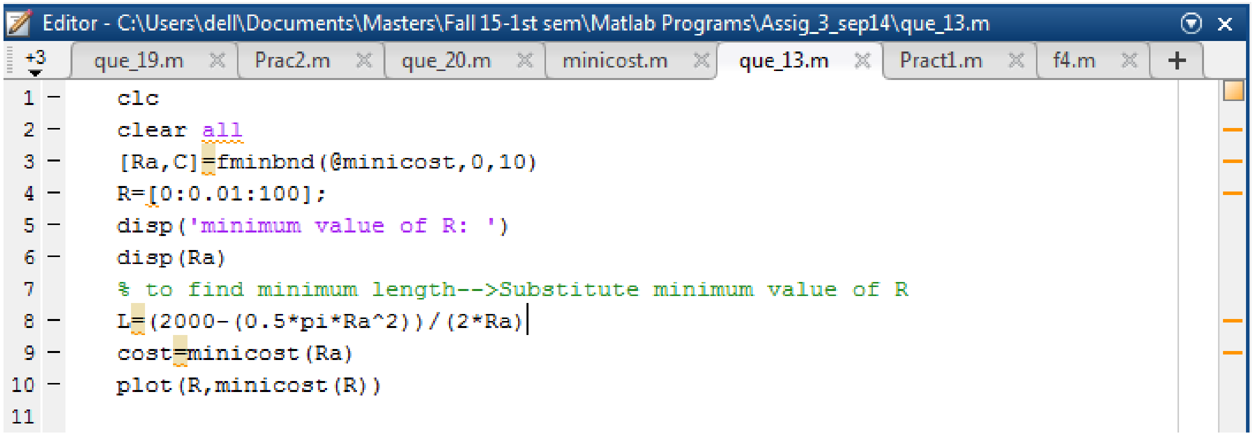
Figure P13

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\minicost.m

que_19.m | Prac2.m | que_20.m | minicost.m | que_13.m | Pract1.m | f4.m

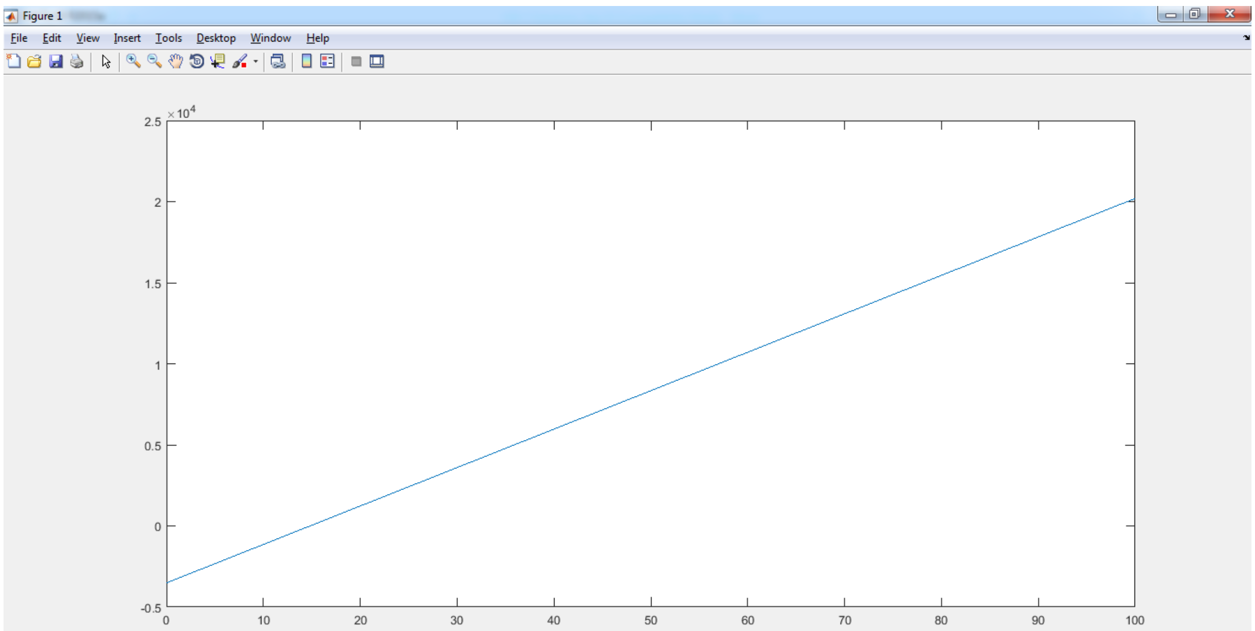
```
function [cost]=minicost(R)
L=(2000-(0.5*pi.*R.^2))/(2.*R);
cost=((2*L+2.*R)*40)+(pi.*R.*50);
```



Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_13.m

que_19.m | Prac2.m | que_20.m | minicost.m | que_13.m | Pract1.m | f4.m

```
clc
clear all
[Ra,C]=fminbnd(@minicost,0,10)
R=[0:0.01:100];
disp('minimum value of R: ')
disp(Ra)
% to find minimum length-->Substitute minimum value of R
L=(2000-(0.5*pi*Ra^2))/(2*Ra)
cost=minicost(Ra)
plot(R,minicost(R))
```



Command Window

```
Ra =

    9.9999


C =

   9.7425e+03

minimum value of R:
    9.9999


L =

   92.1466


cost =

   9.7425e+03
```

23. Use a text editor to create a le containing the following data. Then use the `load` function to load the le into MA TLAB, and use the `mean` function to compute the mean value of each column.

55	42	98
49	39	95
63	51	92
58	45	90

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_23.m

que_22.m | que_19.m | que_24.m | que_5.m | que_6.m | capa.m | que_23.m

```
clc
clear all
A=load('que_23.txt')
B=mean(A)
```

Command Window

```
A =

    55    42    98
    49    39    95
    63    51    92
    58    45    90


B =

   56.2500   44.2500   93.7500
```

20. Create four anonymous functions to represent the function $6e^{3\cos x^2}$, which is composed of the functions $h(z) = 6e^z$, $g(y) = 3\cos y$, and $f(x) = x^2$. Use the anonymous functions to plot $6e^{3\cos x^2}$ over the range $0 \le x \le 4$.

Solution

Editor - C:\Users\dell\Documents\Masters\Fall 15-1st sem\Matlab Programs\Assig_3_sep14\que_20.m

volchange.m | tdec.m | que_19.m | Prac2.m | prac1.m | que_20.m

```
clc
clear all
f=@(x) x.^2;
g=@(y) 3.*cos(y);
h=@(z) 6.*exp(z);
k=@(x) h(g(f(x)));
x=[0:0.1:4];
plot(x,k(x))
```

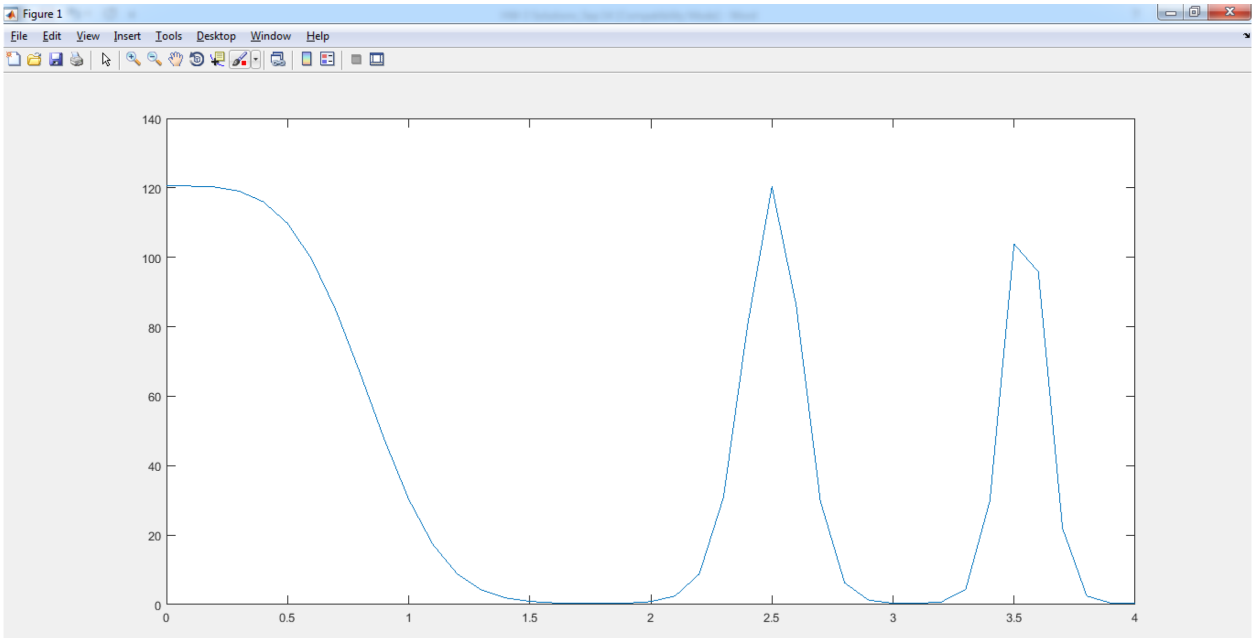


Figure 1
File Edit View Insert Tools Desktop Window Help
140
120
100
80
60
40
20
0
0
0.5
1
1.5
2
2.5
3
3.5
4