CMPE 362
Signal Processing Project 1 Report

Huriye Özdemir

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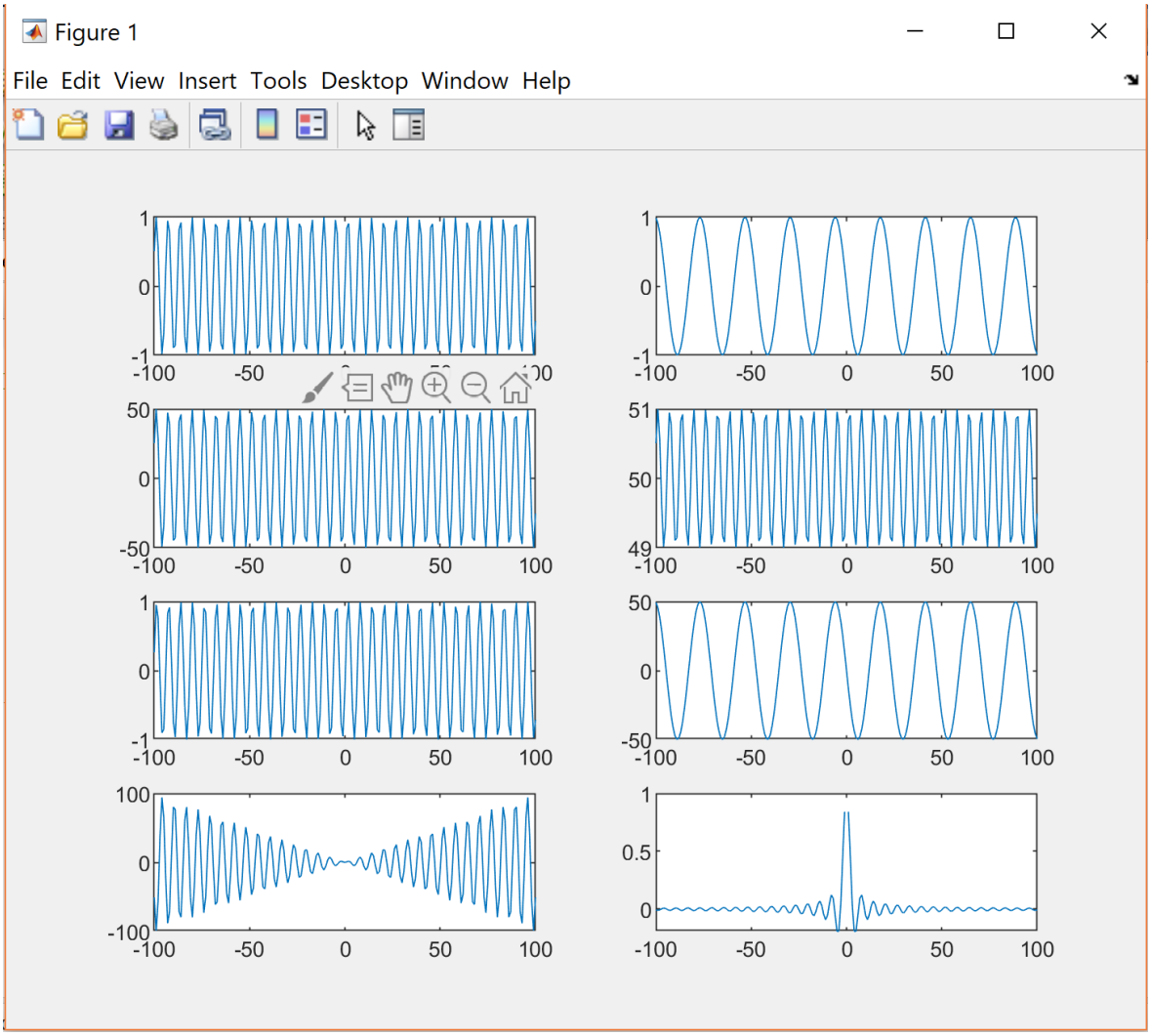
1 Problem 1

In this problem, the x vector that is between -100 and 100 is created to use in different functions we plot. If I interpret the figure, when I give large interval for matris I obtain more smooth waves. There are also frequence differences in functions. To display subfigures in a single figure, I used subplot built-in function.

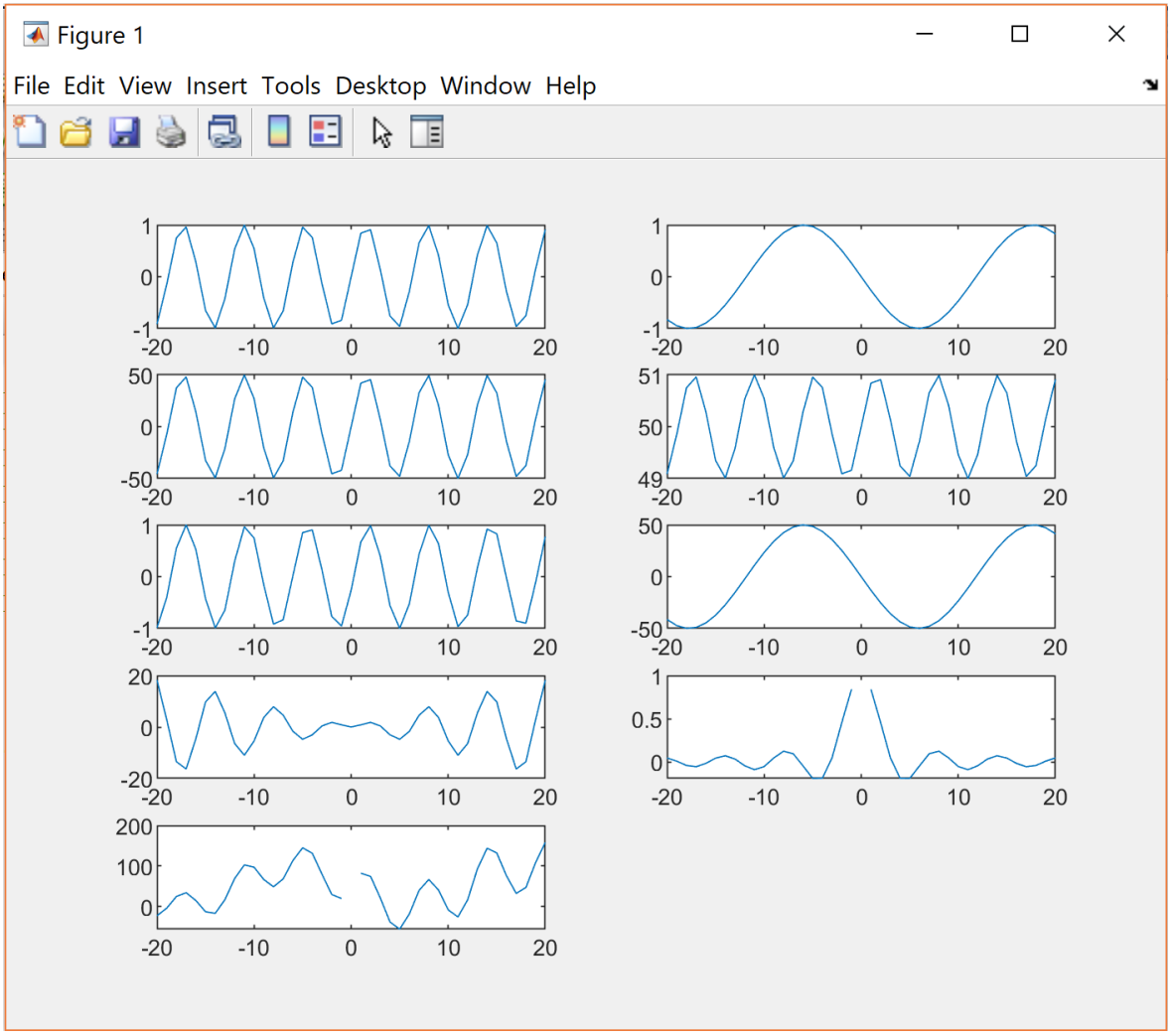


1.1 Source Code

```
%Creates x vector of real numbers (-100:100)
x= -100:100;
y1= sin(x);
y2= sin(50.*x);
y3= 50.*sin(x);
y4= sin(x)+50;
y5= sin(x+50);
y6= 50.*sin(50.*x);
y7= x.*sin(x);
y8= sin(x)./x;

% Plots and subplots(4x2) to fit all subfigures to a single figure
subplot(421), plot(x,y1);
subplot(422), plot(x,y2);
subplot(423), plot(x,y3);
subplot(424), plot(x,y4);
subplot(425), plot(x,y5);
subplot(426), plot(x,y6);
subplot(427), plot(x,y7);
subplot(428), plot(x,y8);
```

2 Problem 2

When I use short interval for vector, I observed that some defects occur on waves for the same functions I use at the previous problem.

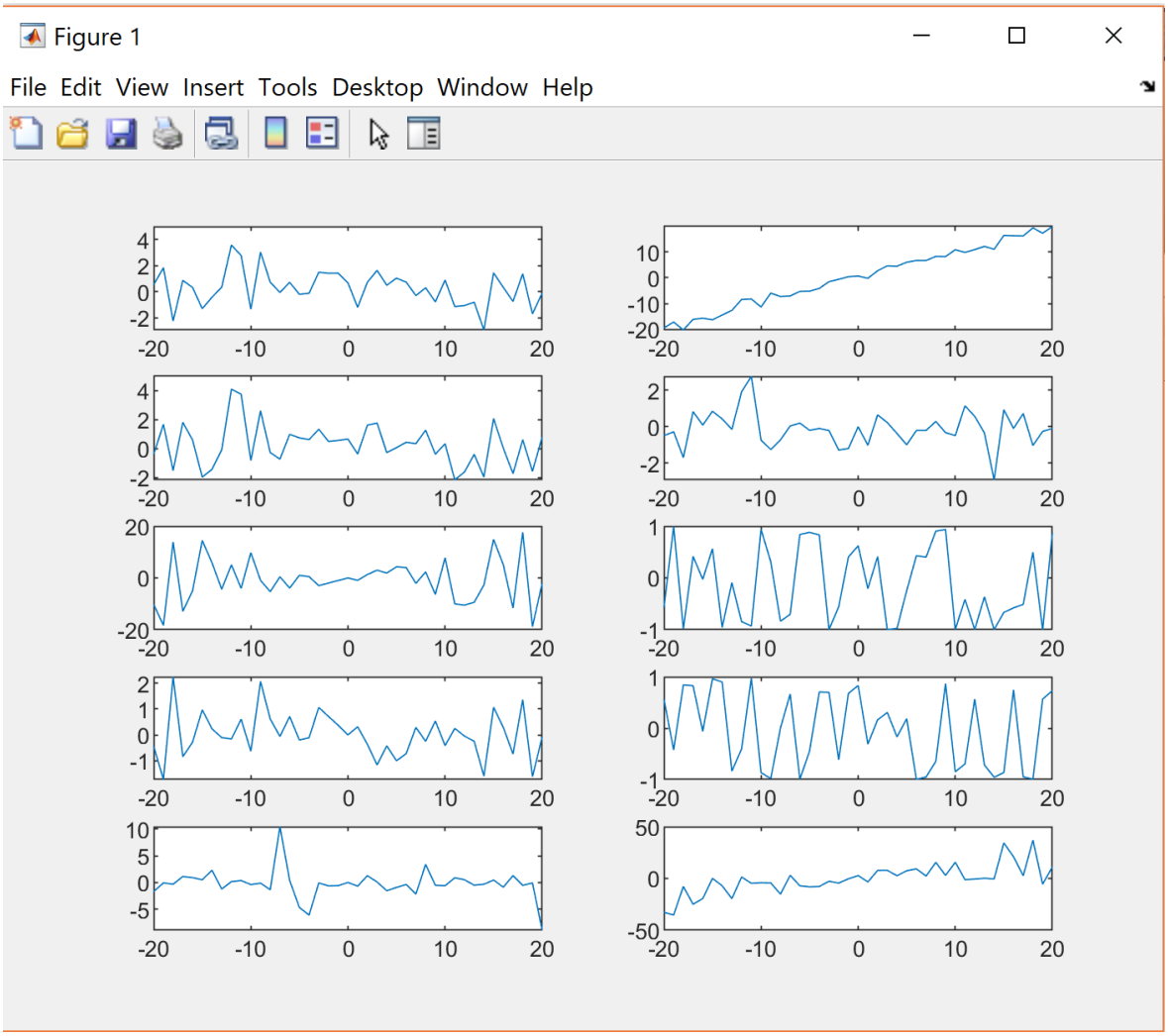


2.1 Source Code

```
% Creates x vector of real numbers (-20:20)
x = -20:20;
y1 = sin(x);
y2=sin(50*x);
y3=50.*sin(x);
y4= sin(x)+50;
y5= sin(x+50);
y6= 50.*sin(50*x);
y7= x.*sin(x);
y8=sin(x)./x;
y9= y1+y2+y3+y4+y5+y6+y7+y8;

% Plots and subplots(5x2) to fit all subfigures to a single figure
subplot(521), plot(x,y1);
subplot(522), plot(x,y2);
subplot(523), plot(x,y3);
subplot(524), plot(x,y4);
subplot(525), plot(x,y5);
subplot(526), plot(x,y6);
subplot(527), plot(x,y7);
subplot(528), plot(x,y8);
subplot(529), plot(x,y9);
```

3 Problem 3

I use "randn" built-in function to generate 41 Gaussian distributed random numbers.

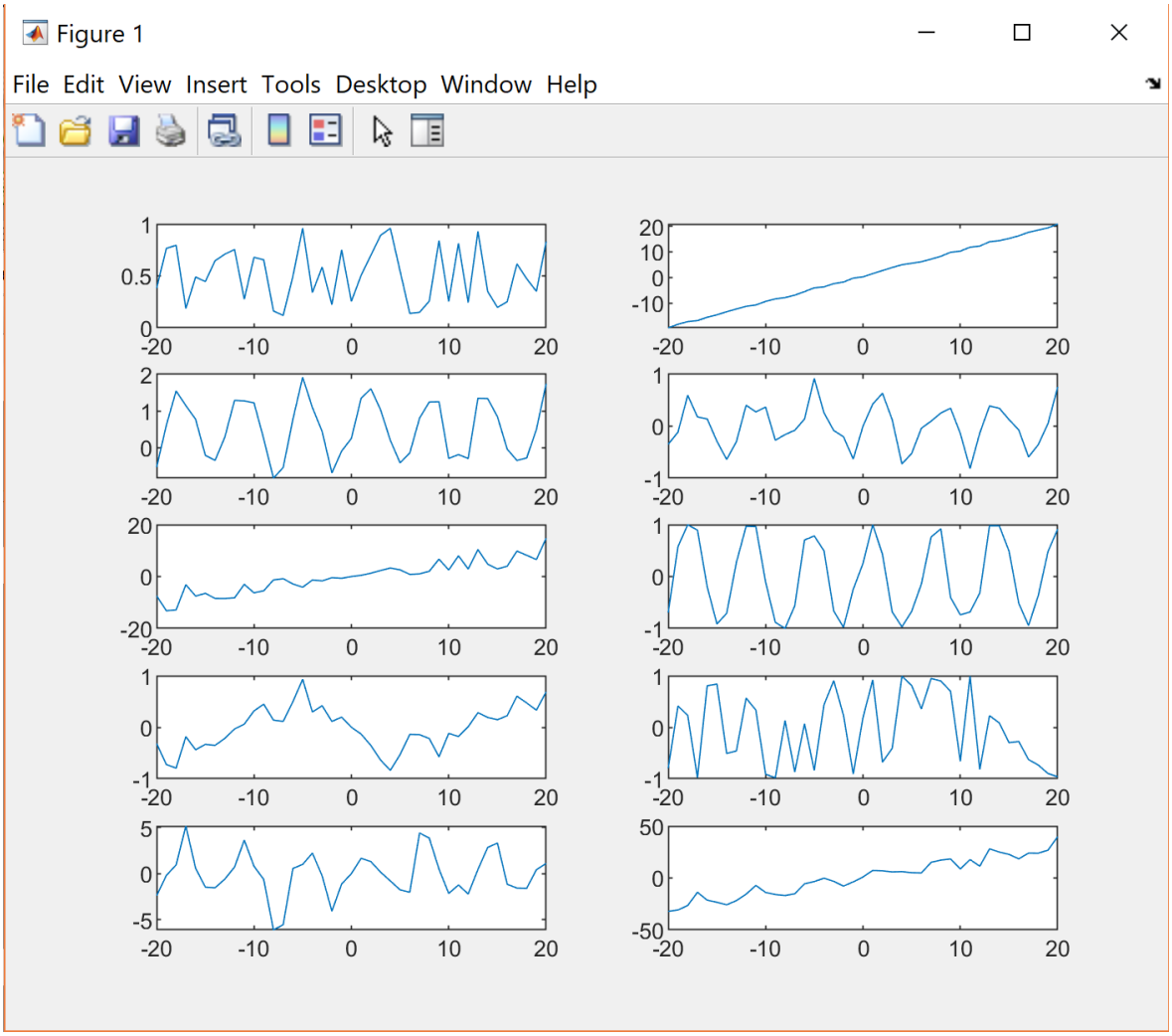


3.1 Source Code

```
x = -20:20;
%Generates 41 random numbers using Gaussian distributed number
z = randn(1,41);

y10= z;
y11= z+x;
y12= z+sin(x);
y13= z.*sin(x);
y14=x.*sin(z);
y15= sin(x+z);
y16= z.*sin(50*x);
y17=sin(x+50*z);
y18=sin(x)./z;
y19= y11+y12+y13+y14+y15+y16+y17+y18;

% Plots and subplots(5x2) to fit all subfigures to a single figure
subplot(521), plot(x,y10);
subplot(522), plot(x,y11);
subplot(523), plot(x,y12);
subplot(524), plot(x,y13);
subplot(525), plot(x,y14);
subplot(526), plot(x,y15);
subplot(527), plot(x,y16);
subplot(528), plot(x,y17);
subplot(529), plot(x,y18);
subplot(5,2,10), plot(x,y19);
```

4 Problem 4

I use "rand" built-in function to generate 41 uniformly distributed random numbers between 0 and 1.

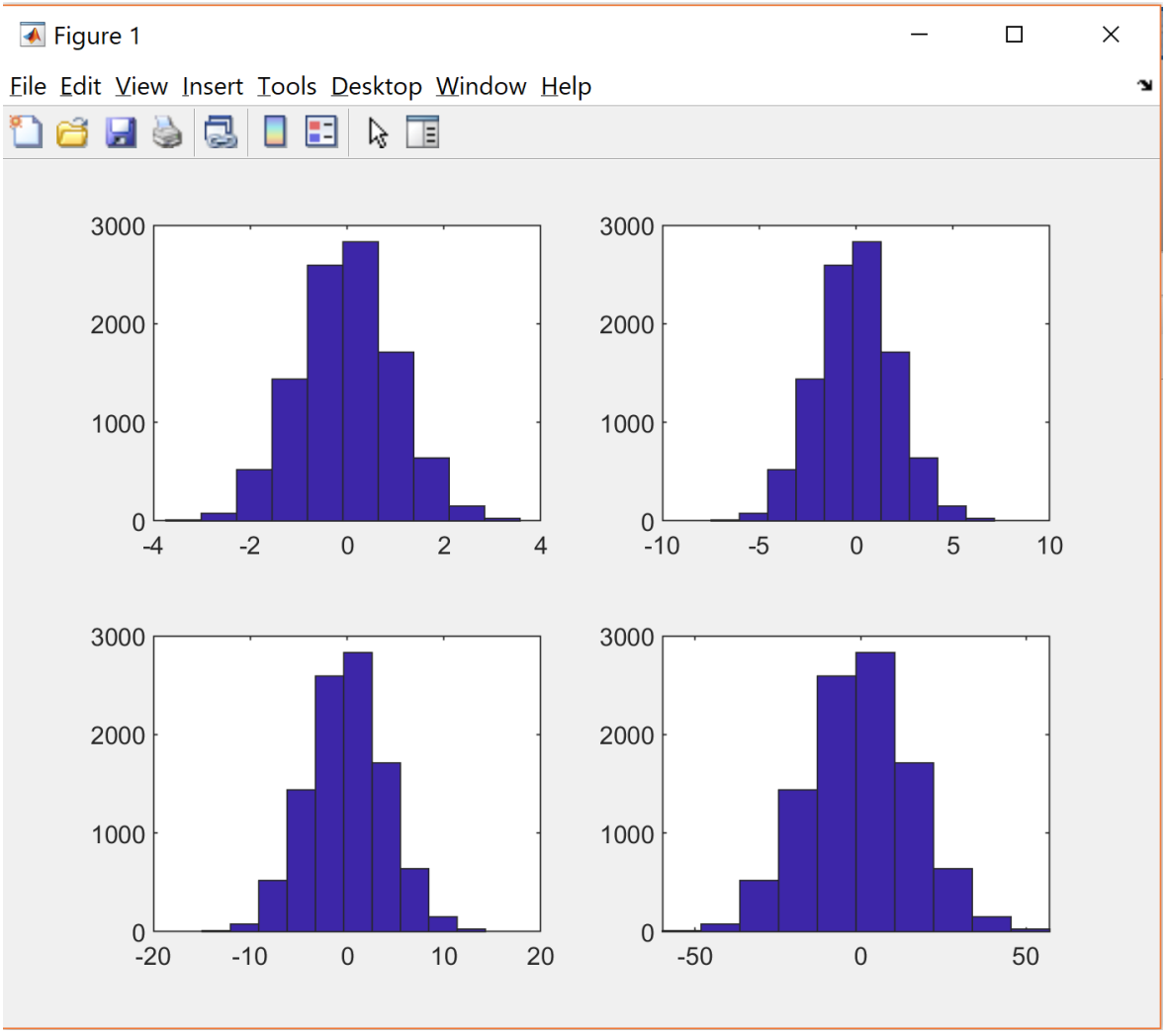


4.1 Source Code

```
x = -20:20;
% Generates 41 uniformly distributed numbers
z = rand(1,41);

y20= z;
y21= z+x;
y22= z+sin(x) ;
y23= z.*sin(x) ;
y24= x.*sin(z) ;
y25= sin(x+z);
y26= z.*sin(50*x);
y27= sin(x+50*z);
y28= sin(x)./z ;
y29= y21+y22+y23+y24+y25+y26+y27+y28;

% Plots and subplots(5x2) to fit all subfigures to a single figure
subplot(5,2,1), plot(x, y20);
subplot(5,2,2), plot(x, y21);
subplot(5,2,3), plot(x, y22);
subplot(5,2,4), plot(x, y23);
subplot(5,2,5), plot(x, y24);
subplot(5,2,6), plot(x, y25);
subplot(5,2,7), plot(x, y26);
subplot(5,2,8), plot(x, y27);
subplot(5,2,9), plot(x, y28);
subplot (5,2,10) , plot (x, y29);
```

5 Problem 5

In order to find out how many of the values in a group, I have drawn a histogram graph with "hist". I used normal random variable with using "randn" function. It created normal distribution that the mean is at the peak. The larger the variance, the greater the difference between the smallest value and the largest value.

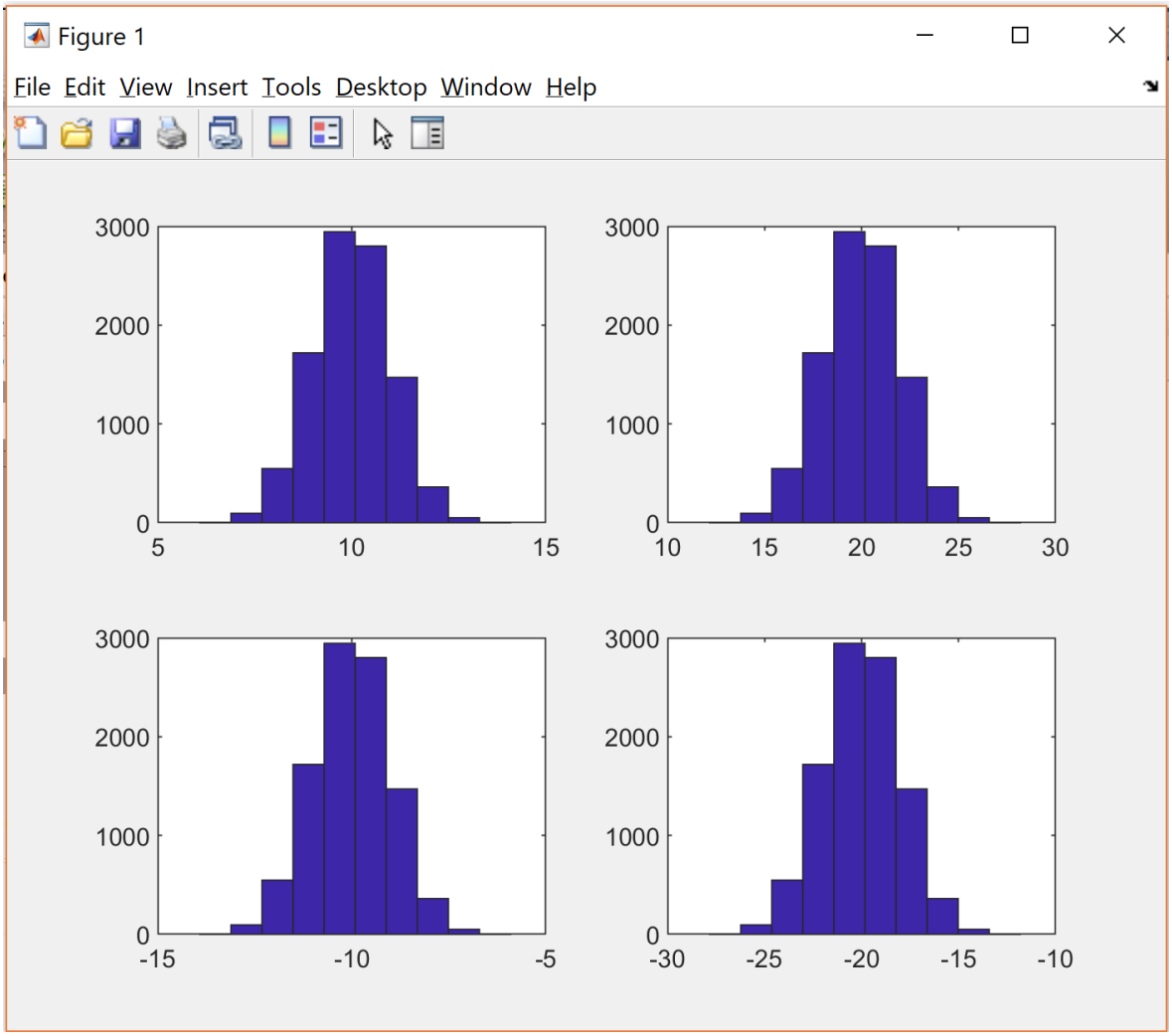


5.1 Source Code

```
% Generates 10000 Gaussian random number variables
z = randn(1,10000);

%Generates 10000 random numbers by
%creating vectors that means are zero and variances are 1,4,16,256
r1 = 0 + sqrt(1) .* z;
r2 = 0 + sqrt(4) .* z;
r3 = 0 + sqrt(16) .* z;
r4 = 0 + sqrt(256) .* z;

% Subplots(2x2) and plots to create histograms
subplot(2,2,1), hist(r1);
subplot(2,2,2), hist(r2);
subplot(2,2,3), hist(r3);
subplot(2,2,4), hist(r4);
```

6 Problem 6

In this problem, even I change the means and variances, the normal distribution of the variables did not change.

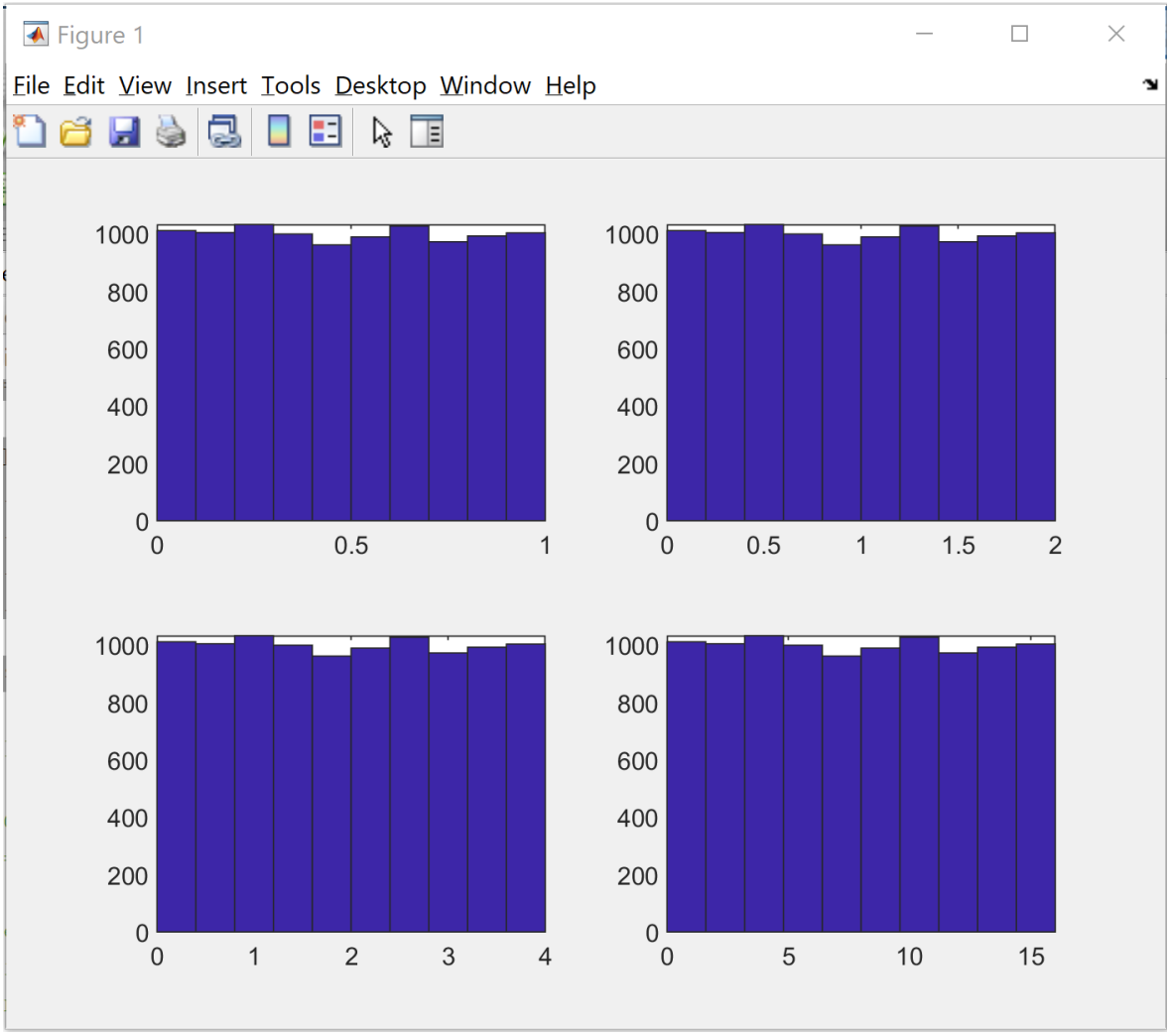


6.1 Source Code

```
% Generates 10000 Gaussian random number variables
z = randn(1,10000);

%Generates 10000 random numbers by
%creating vectors that means are 10,20,-10,-20
%and variances are 1,4,1,4
r6 = 10 + sqrt(1) .* z;
r7 = 20 + sqrt(4) .* z;
r8 = -10 + sqrt(1) .* z;
r9 = -20 + sqrt(4) .* z;

% Subplots(2x2) and plots to create histograms
subplot(2,2,1), hist(r6);
subplot(2,2,2), hist(r7);
subplot(2,2,3), hist(r8);
subplot(2,2,4), hist(r9);
```

7 Problem 7

Unlike problem 5 and 6, I used "rand" function to create uniform distribution in this problem. Because the random variables are between 0 and 1,the distribution formed more straight.

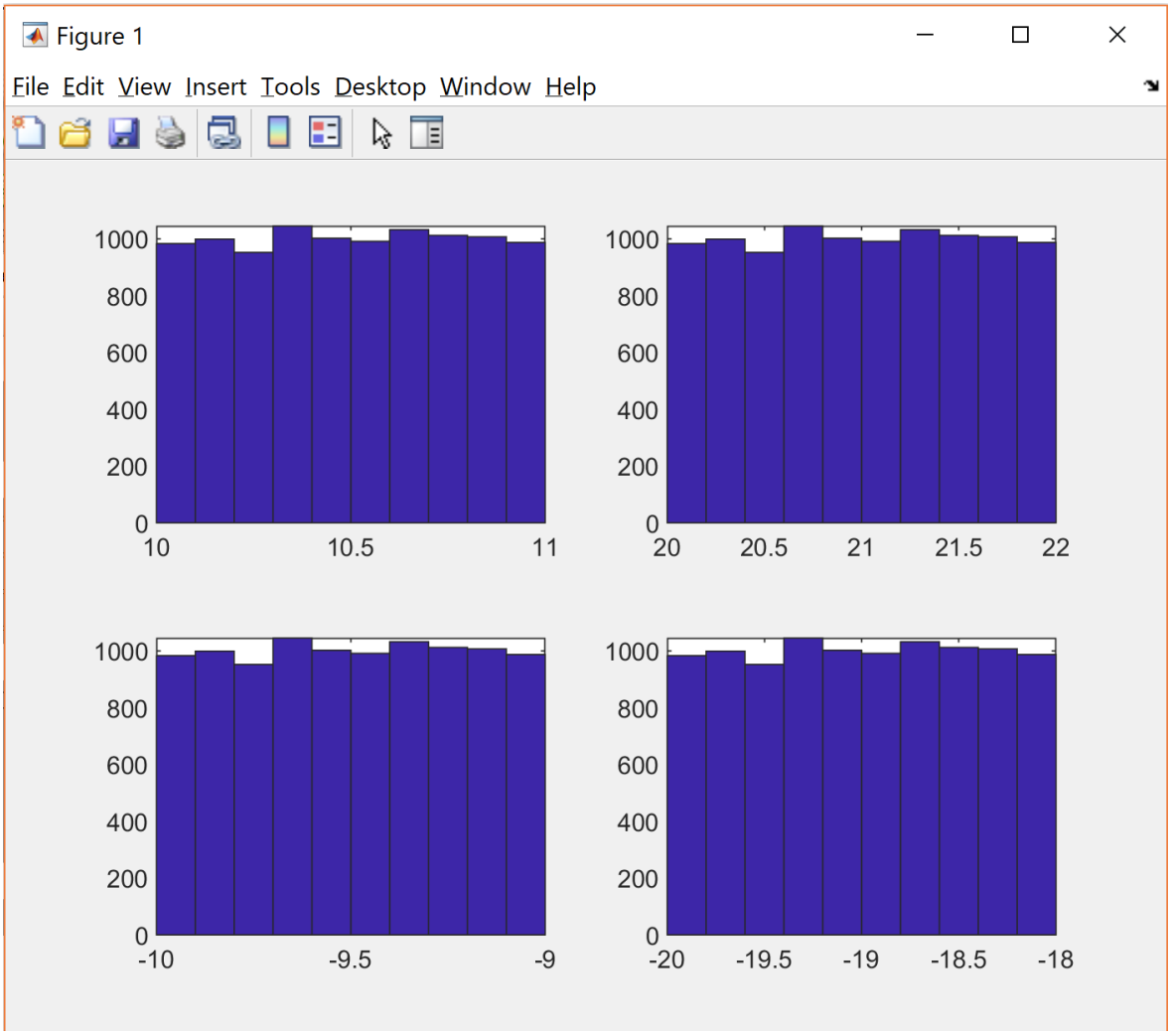


7.1 Source Code

```
% Generates 10000 uniformly distributed random number variables
z = rand(1,10000);

%Generates 10000 random numbers by
%creating vectors that means are zero and variances are 1,4,16,256
r11 = 0 + sqrt(1) .* z;
r21 = 0 + sqrt(4) .* z;
r31 = 0 + sqrt(16) .* z;
r41 = 0 + sqrt(256) .* z;

% Subplots(2x2) and plots to create histograms
subplot(2,2,1), hist(r11);
subplot(2,2,2), hist(r21);
subplot(2,2,3), hist(r31);
subplot(2,2,4), hist(r41);
```

8 Problem 8

In this problem, even I change the means and variances, the uniformly distribution of the variables is very similar to previous one.

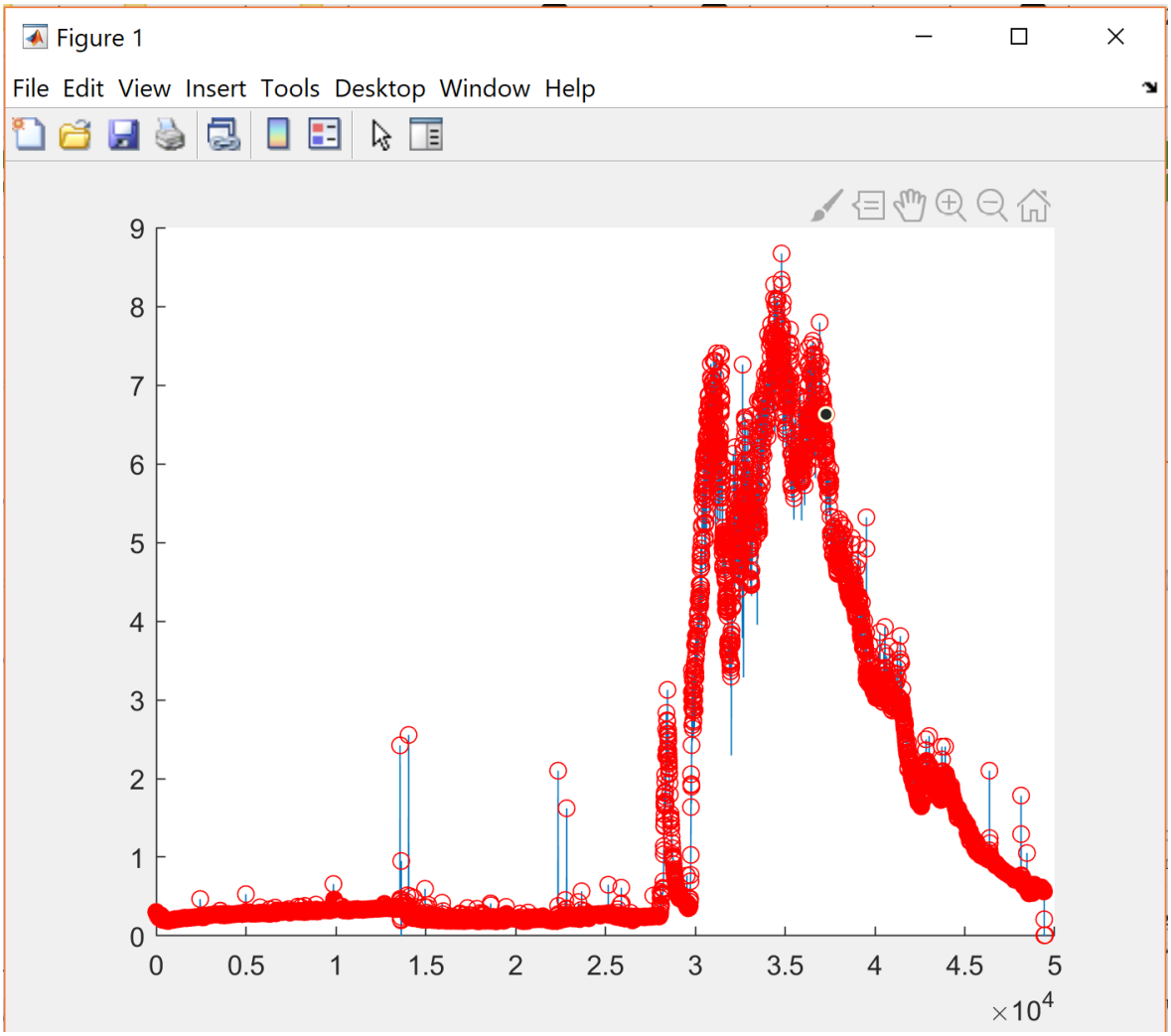


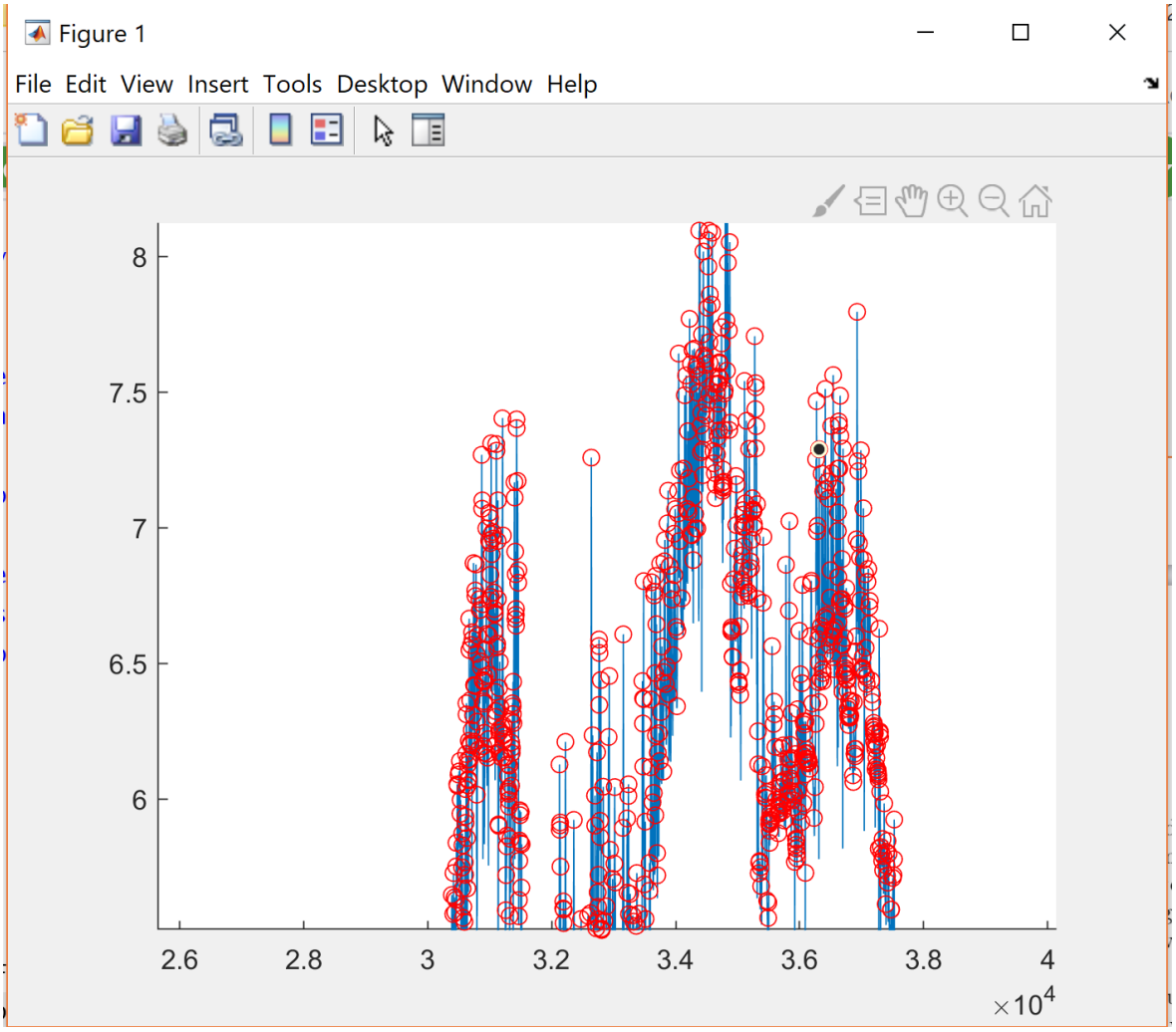
8.1 Source Code

```
% Generates 10000 uniformly distributed random number variables
z = rand(1, 10000);

%Generates 10000 random numbers by
%creating vectors that means are 10,20,-10,-20
%and variances are 1,4,1,4

r61 = 10 + sqrt(1) .* z;
r71 = 20 + sqrt(4) .* z;
r81 = -10 + sqrt(1) .* z;
r91 = -20 + sqrt(4) .* z;

% Subplots(2x2) and plots to create histograms
subplot(2,2,1), hist(r61);
subplot(2,2,2), hist(r71);
subplot(2,2,3), hist(r81);
subplot(2,2,4), hist(r91);
```

9 Problem 9

In this problem, I determined all the peaks for the provided .csv file and marked them. When I analyze to detect found or missed peaks, I saw that many of them found by the algorithm. Some peaks cannot be found because they are very close together and frequent dots. The second picture is closer view of the figure to see detected peaks.





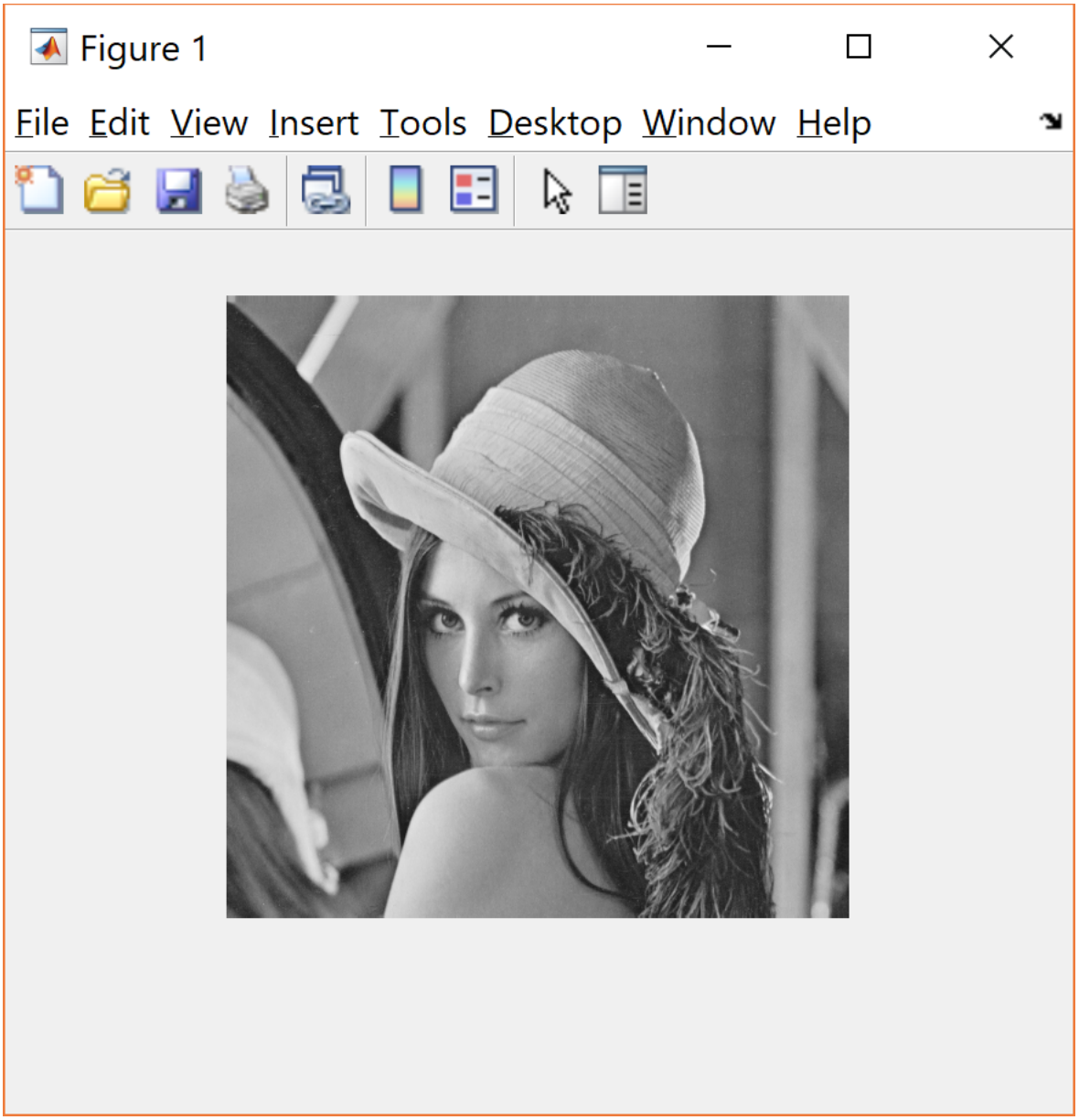
9.1 Source Code

```
% Reads the data from the csv file and skips the first 3 elements
M =csvread('exampleSignal.csv',4,0);

% Sets the time domain
t =(1:49498);

%Finds all the peaks and locations from the csv file
[peaks ,l]= findpeaks(M);

%Plots and marks detected peaks
plot(t,M,t(l),peaks,'or');
```

10 Problem 10

I used rgb2gray, mean2, std2, max and min built-in functions for this problem. The output values are :

```
mean_val = 124.0425
std_val = 47.8556
maxval = uint8 245
max_row = 274
max_col = 396
minval = uint8 25
min_row = 72
min_col = 4
```



10.1 Source Code

```
% Reads image 'lena.png' with imread
A = imread("lena.png")
%Converts rgb to gray
I = rgb2gray(A);
imshow(I);

%Calculates mean, standard deviation and displays them
mean_val = mean2(I)
std_val= std2(I)

% Calculates the maximum and its location
maxval= max(max(I(:)))
[max_row, max_col] = find(ismember(I, max(I(:))))

% Calculates the minimum and its location
minval= min(min(I(:)))
[min_row, min_col] = find(ismember(I, min(I(:))))
```

11 Comments on MATLAB

Matlab is a very flexible and useful language with many built-in functions. I didn't have much difficulty using it because I was able to reach solutions with mathworks.com or different sources.