Cmpe362 – Homework 1 (08.03.2020)

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1. CODE & COMMENTS

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%%PROBLEM 1
figure(1); %plot problem 1 in a single figure window
t = (-2:0.01:2); %define t
%define y values
y1 = sin(2*pi*t);
y2 = sin(2*pi*10*t);
y3 = 10*sin(2*pi*t);
y4 = sin(2*pi*t)+10;
y5 = sin(2*pi*(t-0.5));
y6 = 10*sin(2*pi*10*t);
y7 = t.*sin(2*pi*t);
y8 = sin(2*pi*t)./t;
y9 = y1+y2+y3+y4+y5+y6+y7+y8;

%plot t and all y values in subplots
subplot(5,2,1);plot(t);
subplot(5,2,2);plot(y1);
subplot(5,2,3);plot(y2);
subplot(5,2,4);plot(y3);
subplot(5,2,5);plot(y4);
subplot(5,2,6);plot(y5);
subplot(5,2,7);plot(y6);
subplot(5,2,8);plot(y7);
subplot(5,2,9);plot(y8);
subplot(5,2,10);plot(y9);


%%PROBLEM 2
figure(2); %plot the problem 2 in a different figure window
z = randn(401,1).*0.1; %create 401 random variables multiply with 0.1
%create y values
y10 = z;
y11 = z+t;
y12 = z+y1;
y13 = z.*y1;
y14 = t.*sin(2*pi*z);
y15 = sin(2*pi*(t+z));
y16 = z.*y2;
y17 = sin(2*pi*(t+10*z));
y18 = y1./z;
y19 = y11+y12+y13+y14+y15+y16+y17+y18;

%plot all y values in subplots
subplot(5,2,1);plot(y10);
subplot(5,2,2);plot(y11);
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subplot(5,2,3);plot(y12);
subplot(5,2,4);plot(y13);
subplot(5,2,5);plot(y14);
subplot(5,2,6);plot(y15);
subplot(5,2,7);plot(y16);
subplot(5,2,8);plot(y17);
subplot(5,2,9);plot(y18);
subplot(5,2,10);plot(y19);


%%PROBLEM 3
figure(3); %plot the problem 3 in a different figure window
z = rand(401,1).*0.1; %create 401 random variables multiply with 0.1
%create y values
y20 = z;
y21 = z+t;
y22 = z+y1;
y23 = z.*y1;
y24 = t.*sin(2*pi*z);
y25 = sin(2*pi*(t+z));
y26 = z.*y2;
y27 = sin(2*pi*(t+10*z));
y28 = y1./z;
y29 = y21+y22+y23+y24+y25+y26+y27+y28;

%plot all y values in subplots
subplot(5,2,1);plot(y20);
subplot(5,2,2);plot(y21);
subplot(5,2,3);plot(y22);
subplot(5,2,4);plot(y23);
subplot(5,2,5);plot(y24);
subplot(5,2,6);plot(y25);
subplot(5,2,7);plot(y26);
subplot(5,2,8);plot(y27);
subplot(5,2,9);plot(y28);
subplot(5,2,10);plot(y29);


%%PROBLEM 4
figure(4);  %plot the problem 4 in a different figure window
r1 = normrnd(0,1,[5000,1]); % generate 5000 random variables with mean 0, variance 1
r2 = normrnd(0,sqrt(8),[5000,1]); % generate 5000 random variables with mean 0, variance 8;
r3 = normrnd(0,4,[5000,1]); % generate 5000 random variables with mean 0, variance 16;
r4 = normrnd(0,8,[5000,1]); % generate 5000 random variables with mean 0, variance 64;

%plot all r1-4 values in subplots
subplot(4,1,1);histogram(r1);
subplot(4,1,2);histogram(r2);
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subplot(4,1,3);histogram(r3);
subplot(4,1,4);histogram(r4);


%%PROBLEM 5
figure(5); %plot the problem 5 in a different figure window
r6 = normrnd(10,1,[5000,1]); % generate 5000 random variables with mean 10,
variance 1
r7 = normrnd(20,2,[5000,1]); % generate 5000 random variables with mean 20,
variance 4
r8 = normrnd(-10,1,[5000,1]); % generate 5000 random variables with mean
-10, variance 1
r9 = normrnd(-20,2,[5000,1]); % generate 5000 random variables with mean
-20, variance 4

%plot all r6-9 values in subplots
subplot(4,1,1);histogram(r6);
subplot(4,1,2);histogram(r7);
subplot(4,1,3);histogram(r8);
subplot(4,1,4);histogram(r9);


%%PROBLEM 6
figure(6); % plot the problem 6 in a different figure window
r11 = rand(5000,1)*8-4; % generate 5000 random variables with between -4
and 4
r21 = rand(5000,1)*40-20; % generate 5000 random variables with between -20
and 20;

%plot r11 and 21 values in subplots
subplot(2,1,1);histogram(r11);
subplot(2,1,2);histogram(r21);


%%PROBLEM 7
load('mysignal.mat'); % load the file
figure(1);
n = length(x); % find the length of signal
S = fft(x); % apply Fourier transform
f = (0:n-1)*(fs/n); % frequency range
power = abs(S).^2/n; % power of signal
plot(f, power); % plot the power

figure(2);
Y = fftshift(S); % shift zero-freq component
fshift = (-n/2:n/2-1)*(fs/n); % zero-centered frequency range
powerShift = abs(Y).^2/n; % zero-centered power
plot(fshift, powerShift);


%%PROBLEM 9
x = imread('lena.png'); % read the image ‘lena.png’
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x = rgb2gray(x); % convert the rgb image into a grayscale image
meanValue = mean(x(:)); % calculate the mean of the image
stdValue = std(double(x)); % calculate the standard deviation of the image
maxValue = max(x(:)); % find the max value of the image
minValue = min(x(:)); % find the min value of the image
[rowMax, colMax] = find(x == maxValue); %find the location of the max value
[rowMin, colMin] = find(x == minValue); % find the location of the min value
```

2. EXPLANATION

- In problem 1, we assigned a vector to a variable t. We generated sinus waves (y values) with t value. Y1 is our first sinus wave, which has 2*pi frequency, and y2 is another sinus wave with 2*pi*10 frequency. Y1 and y2 show us how do sinus waves change with frequency. Y2 produces more waves than y1 because it has a higher frequency. Y3 equals to 10 times of y1. Therefore, its amplitude becomes between 10 and -10. Y4 adds 10 to y1. It does not change the shape of the wave but the value. Its value becomes between 9 and 10. Y5 does not also change the shape of it, only shifts the y1 wave. Y6 likes y3, multiplies the amplitude of y2 to 10. Y7 multiplies y1 with t, which changes all the waveform. As y7, y8 produces a new waveform with dividing y1 to t. Y9 takes the sum of all waves. Because the waves have different frequencies, y9 has a different frequency.

- In the second problem, we should declare a vector at first. It is called z and consists of 401 random variables. Other y values are provided with z or y values. These random variables have zero mean with the randn function.

- In the third problem, we did the same thing in 2. However, we chose z with different random variables. These random variables do not have zero mean since they are between 0 and 1.

- The fourth problem has 4 vectors, which have 5000 random variables. Their mean is zero, but variances are different. Since it has zero mean, it is centered on zero. With different variances, they spread different areas. The distribution with variance 64 covers more area than others.

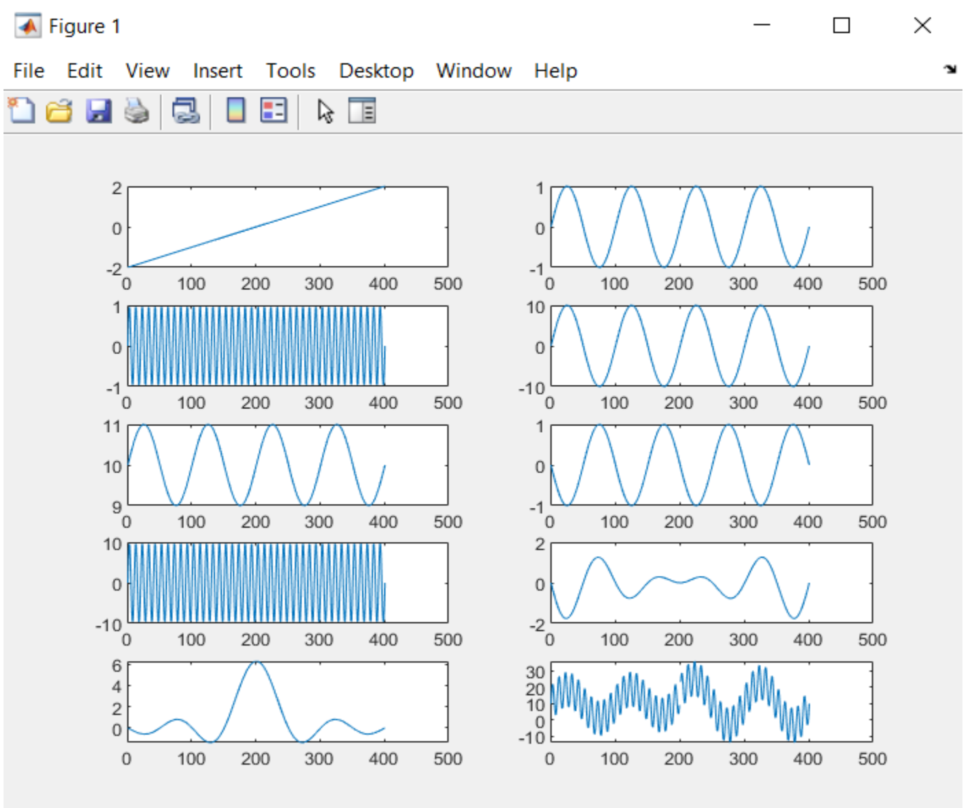
- The fifth problem has also 4 vectors with 5000 random variables. Their mean and variance are different from each other. This is the same as problem 4, but with a different mean. Their means determine the center of distributions. Variances determine the width of them.

- In the sixth problem, we want to generate variables in between some intervals. Rand function generates variables between 0 and 1. Therefore, to generate in a certain interval, we multiply with twice of it. Then subtraction gives us the interval.

- For the seventh question, we used fft function which applies to Fourier transform to the signal. After we applied Fourier transformation to the signal and plotted it, we applied another function called fftshift. It shifts the signal zero-frequency components to the center of the spectrum.
  X(t) = 2170 + 2*2170*cos(2*25*pi*t + Q1) + 2*2170*cos(2*65*pi*t + Q2) + 2*2170*cos(2*120*pi*t + Q3)

- For the ninth problem, we read image with the imread function. The rgb2gray function converts our image to a grayscale image because the original image is in rgb format. Then, we computed the mean, standard deviation, min, and max value of the image. According to min and max value, we found the location of those values.

3. FIGURES



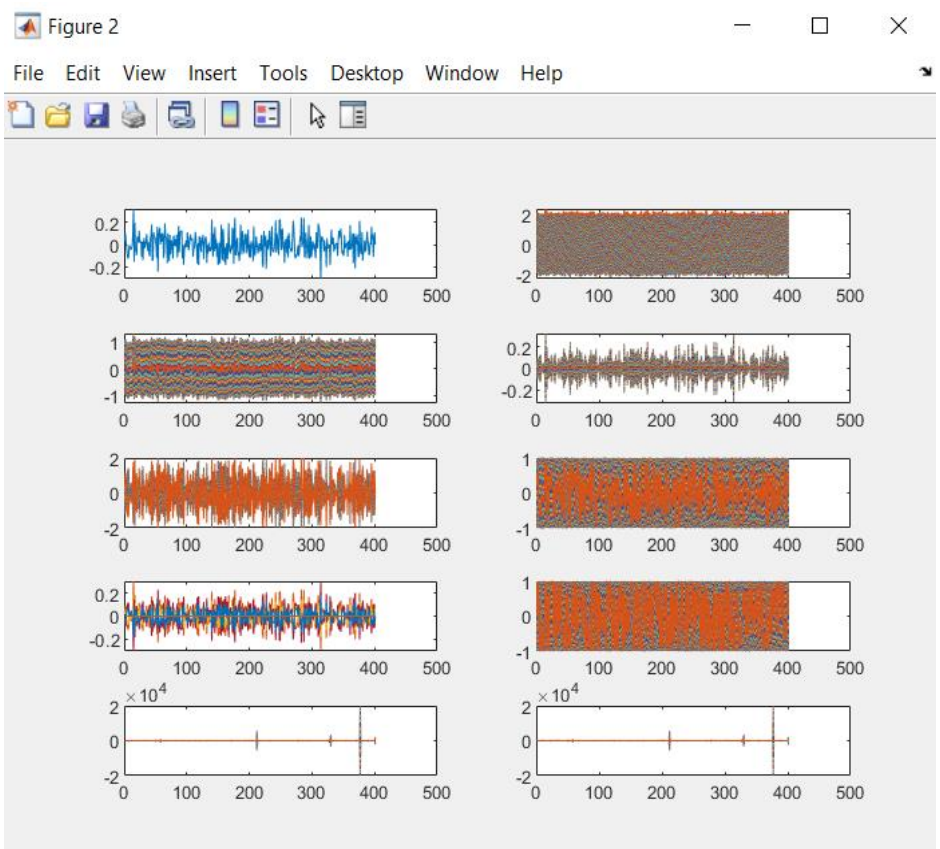


Figure 2
File Edit View Insert Tools Desktop Window Help
0 100 200 300 400 500
0.2
0
-0.2
2
-2
1
-1
×10^4

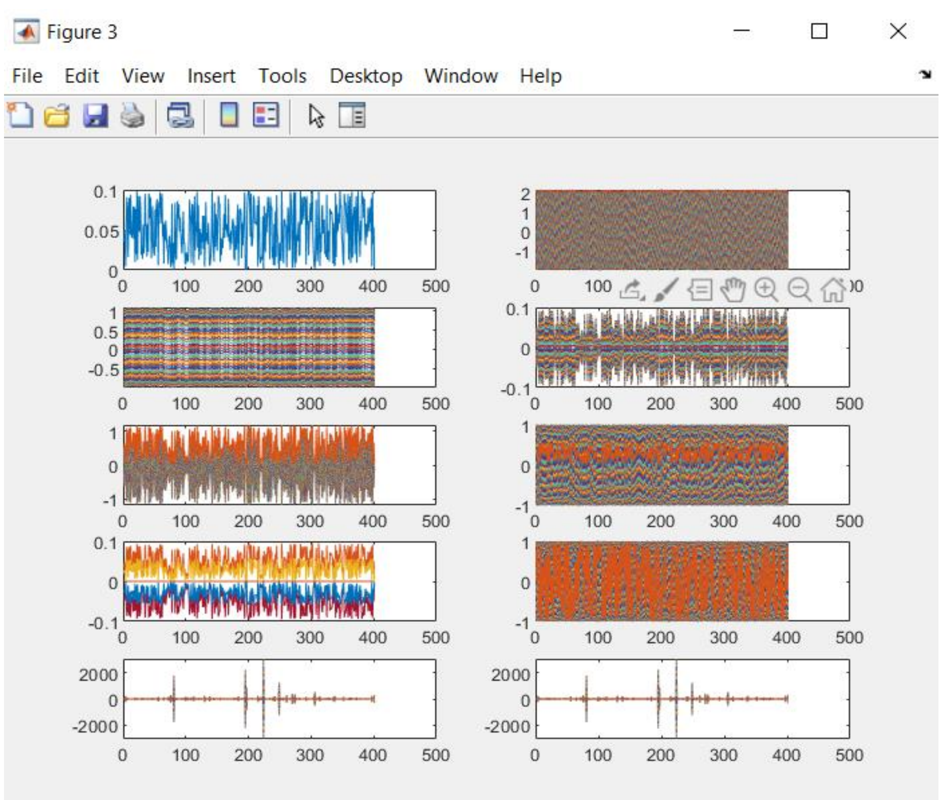


Figure 3
File Edit View Insert Tools Desktop Window Help
0 100 200 300 400 500
0.1
0.05
0
1
0.5
-0.5
-1
2
-0.1
2000
-2000

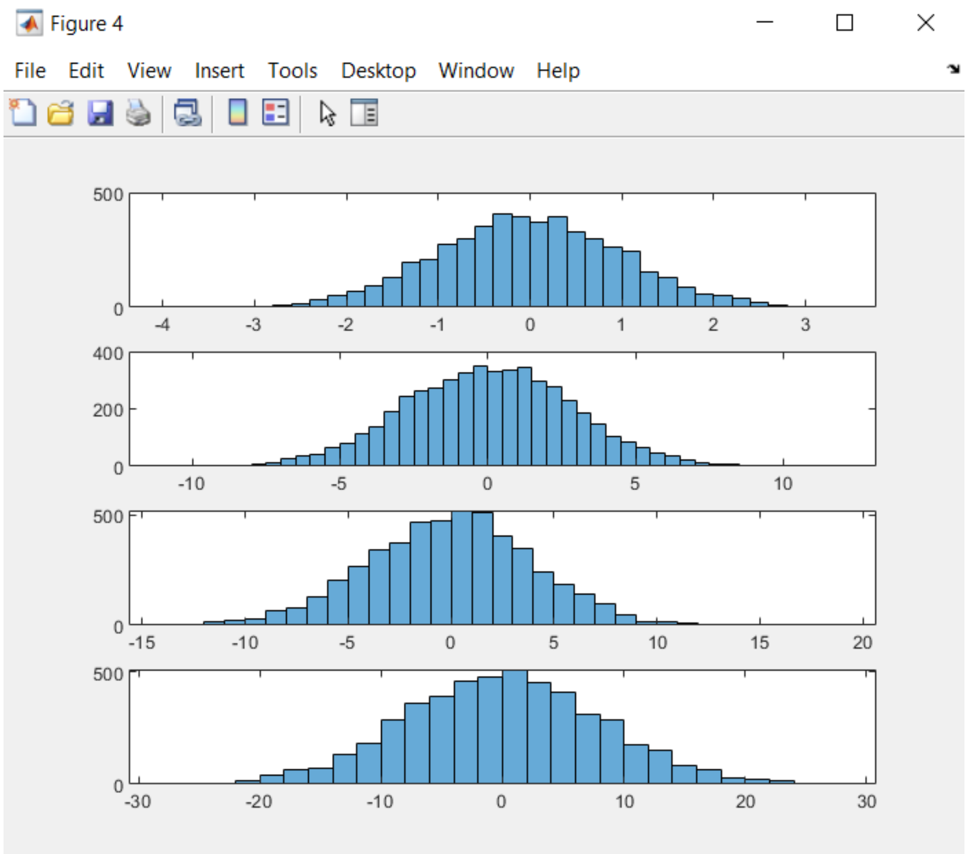


Figure 4
File Edit View Insert Tools Desktop Window Help
500
0
-4 -3 -2 -1 0 1 2 3
400
200
0
-10 -5 0 5 10
500
0
-15 -10 -5 0 5 10 15 20
500
0
-30 -20 -10 0 10 20 30

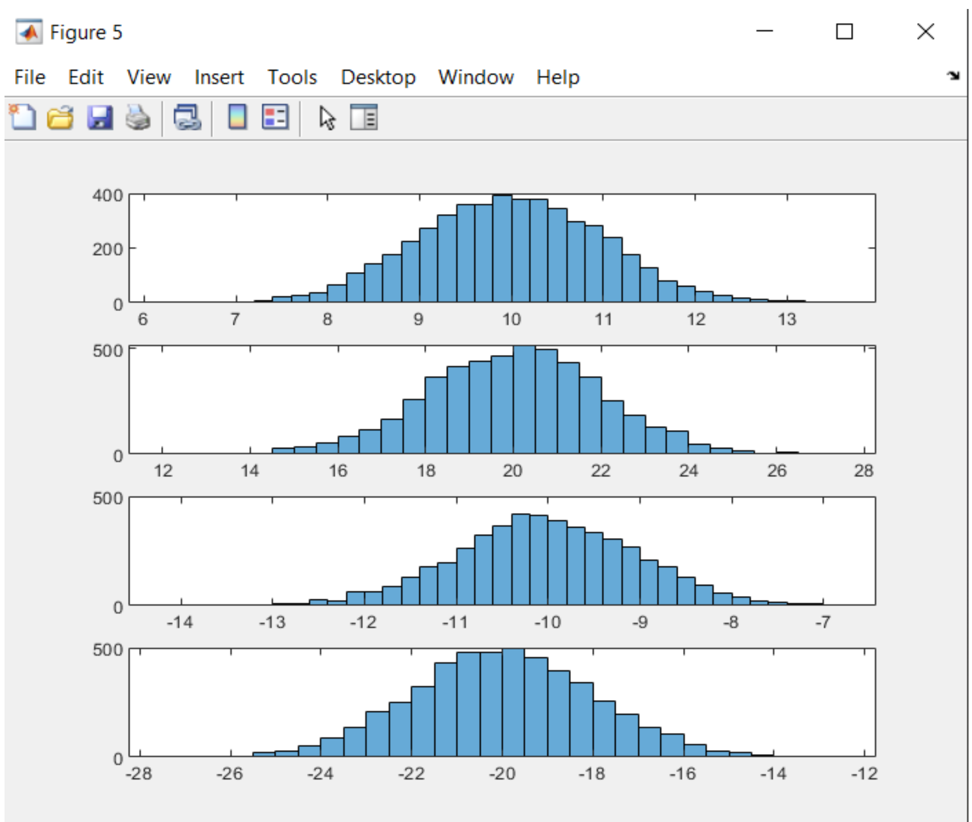


Figure 5
File Edit View Insert Tools Desktop Window Help
400
200
0
6 7 8 9 10 11 12 13
500
0
12 14 16 18 20 22 24 26 28
500
0
-14 -13 -12 -11 -10 -9 -8 -7
500
0
-28 -26 -24 -22 -20 -18 -16 -14 -12

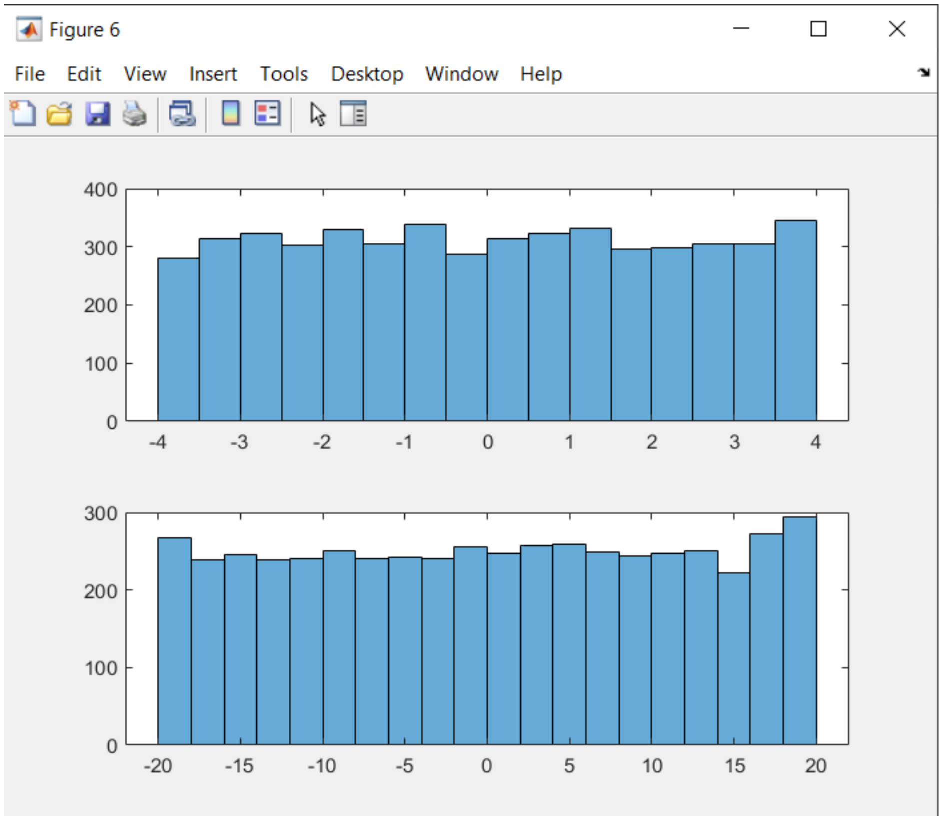


Figure 6
File Edit View Insert Tools Desktop Window Help
400
300
200
100
0
-4 -3 -2 -1 0 1 2 3 4
300
200
100
0
-20 -15 -10 -5 0 5 10 15 20

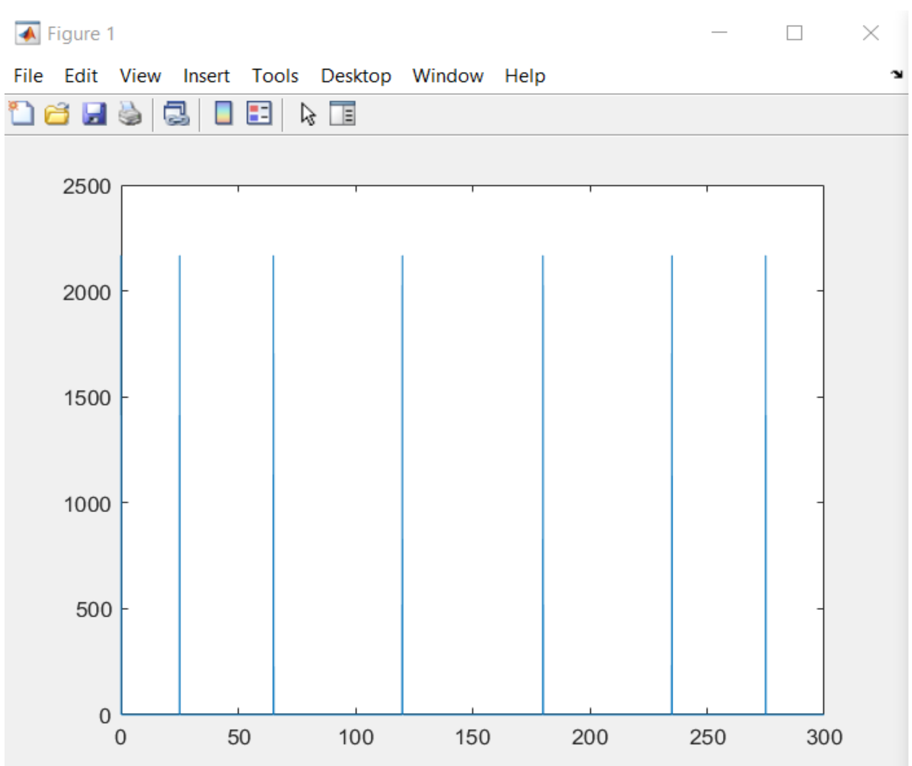


Figure 1
File Edit View Insert Tools Desktop Window Help
2500
2000
1500
1000
500
0
0 50 100 150 200 250 300

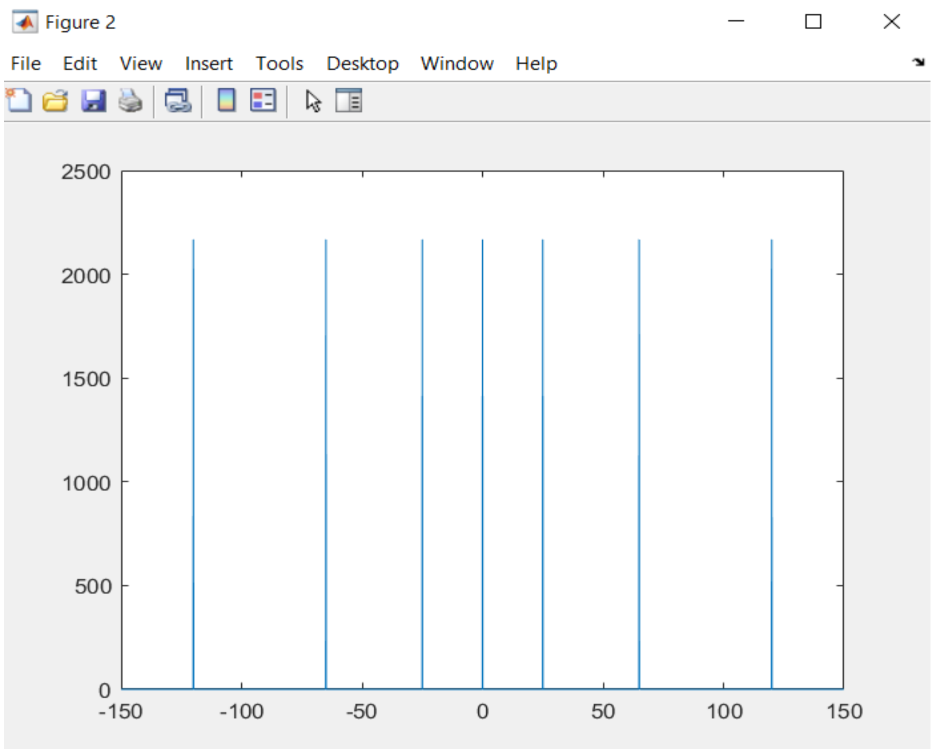


Figure 2
File Edit View Insert Tools Desktop Window Help
2500
2000
1500
1000
500
0
-150
-100
-50
0
50
100
150