CMPE 362 - SIGNAL PROCESSING

HOMEWORK 1

REPORT

I learned how to do elementary operation (division,multiplication..) on Matlab.

I learned how to plot sin functions and I saw the difference between them.

I learned how to generate random variables with certain standard deviation with using randn function(Gaussian distributed).

I learned how to find statistics from image and audio files.

I learned how to add a uniformly distributed a variable which can be created with rand function.

I learned how to use histogram function.

I learned how to manipulate the standart deviation.

I learned how to read the image with imread function.

I learned how to use fft and fftshift functions.

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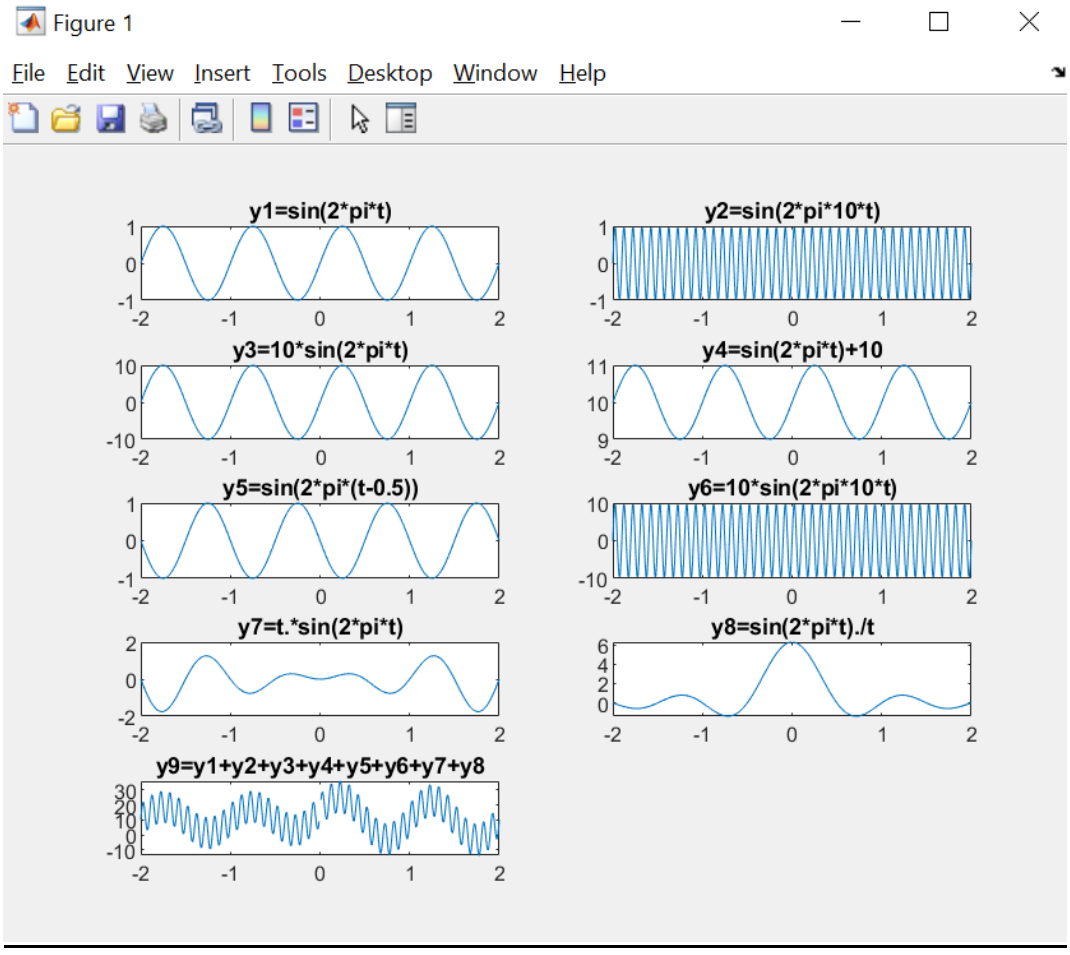
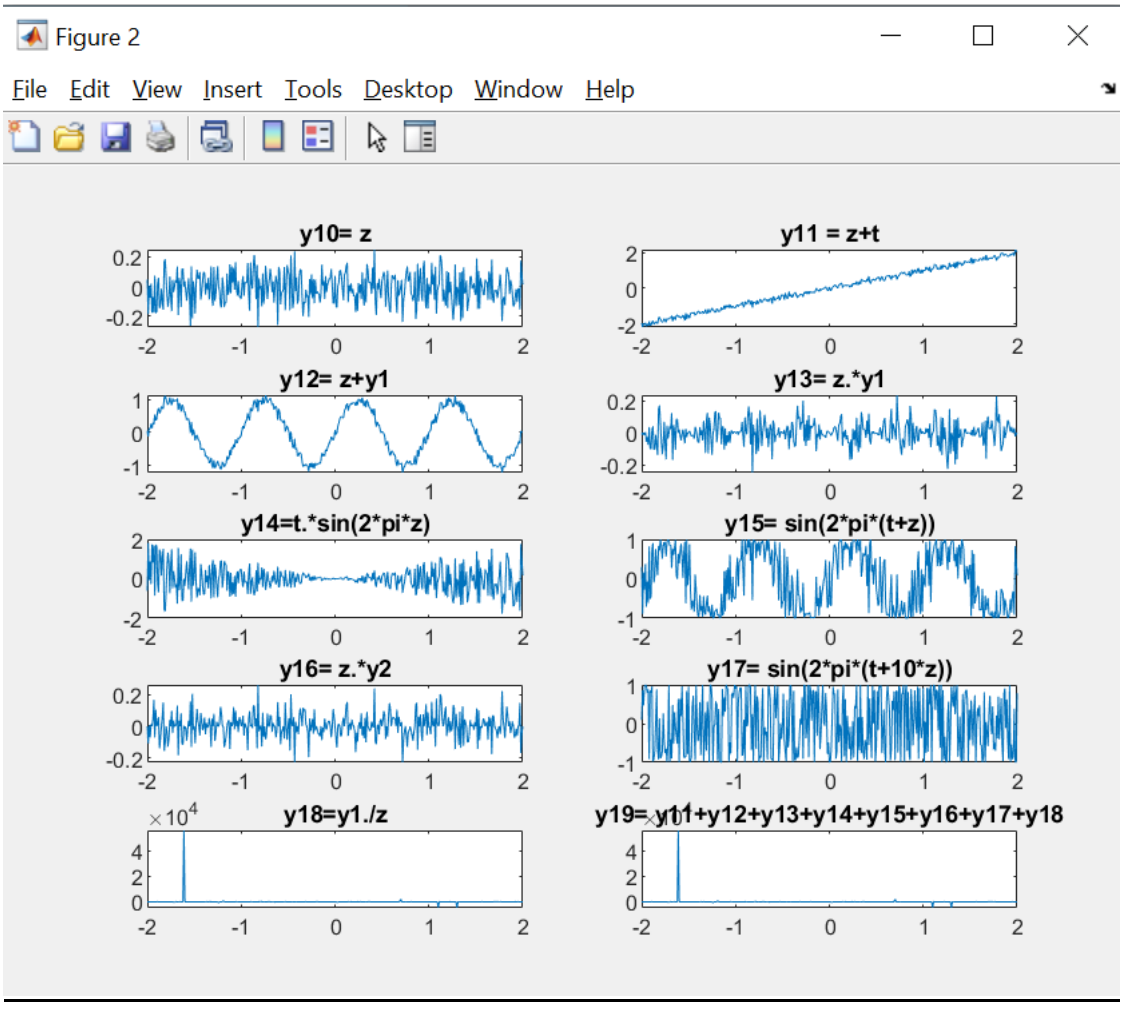
Problem 1

```
%PROBLEM 1
%t is vector of real numbers (-2:0.01:2):
t=-2:0.01:2;%starts at -2, increments by 0.01, and ends at or before 2
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); %To perform elementwise multiplication, use '.*'
y8=sin(2*pi*t)./t;
y9=y1+y2+y3+y4+y5+y6+y7+y8;
subplot(5,2,1); plot(t,y1); title('y1=sin(2*pi*t)');
subplot(5,2,2); plot(t,y2); title('y2=sin(2*pi*10*t)');
subplot(5,2,3); plot(t,y3); title('y3=10*sin(2*pi*t)');
subplot(5,2,4); plot(t,y4); title('y4=sin(2*pi*t)+10');
subplot(5,2,5); plot(t,y5); title('y5=sin(2*pi*(t-0.5))');
subplot(5,2,6); plot(t,y6); title('y6=10*sin(2*pi*10*t)');
subplot(5,2,7); plot(t,y7); title('y7=t.*sin(2*pi*t)');
subplot(5,2,8); plot(t,y8); title('y8=sin(2*pi*t)./t');
subplot(5,2,9); plot(t,y9); title('y9=y1+y2+y3+y4+y5+y6+y7+y8');
```



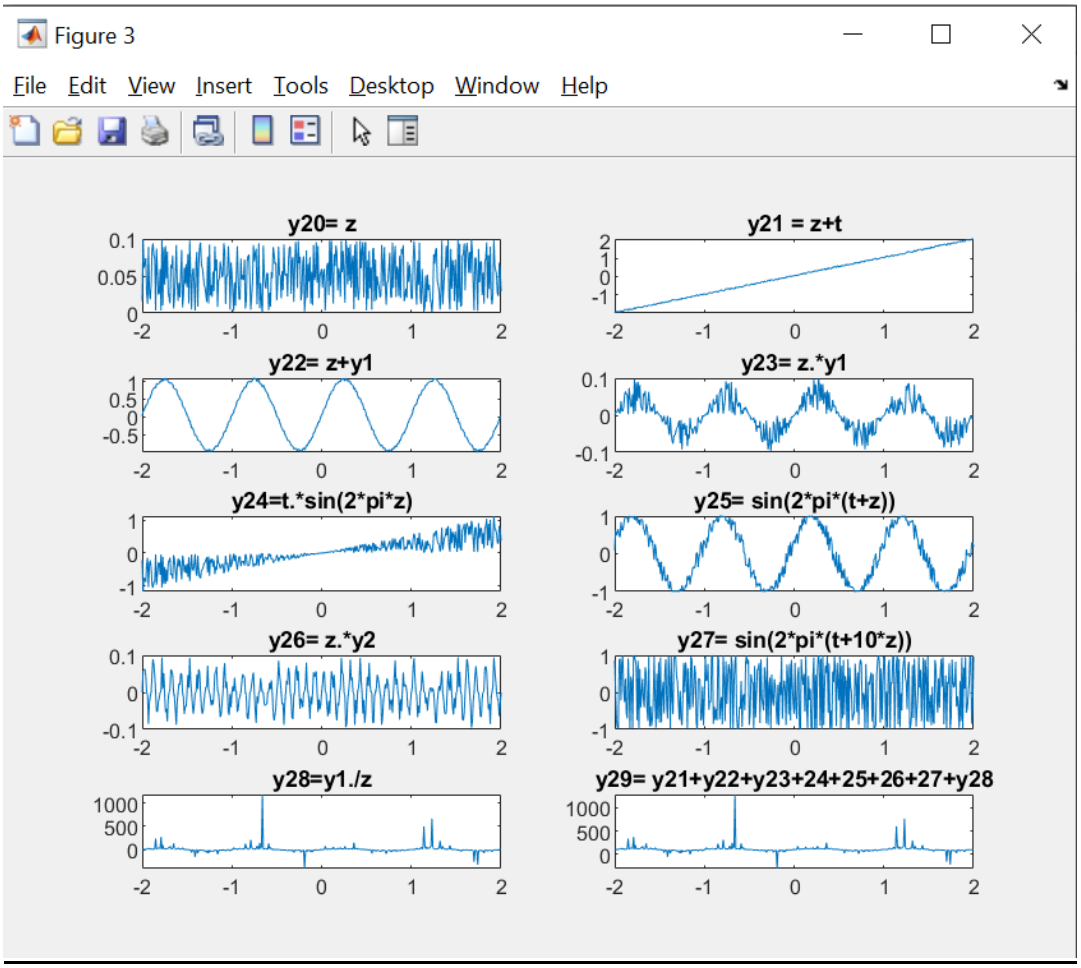
PROBLEM 2

```
% PROBLEM 2
figure;
z=randn(1,401)*0.1; %Generate 401 random numbers following Gaussian distributed random numbers
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;
subplot(5,2,1);plot(t,y10);title('y10= z');
subplot(5,2,2);plot(t,y11);title('y11 = z+t');
subplot(5,2,3);plot(t,y12);title('y12= z+y1');
subplot(5,2,4);plot(t,y13);title('y13= z.*y1');
subplot(5,2,5);plot(t,y14);title('y14=t.*sin(2*pi*z)');
subplot(5,2,6);plot(t,y15);title('y15= sin(2*pi*(t+z))');
subplot(5,2,7);plot(t,y16);title('y16= z.*y2');
subplot(5,2,8);plot(t,y17);title('y17= sin(2*pi*(t+10*z))');
subplot(5,2,9);plot(t,y18);title('y18=y1./z');
subplot(5,2,10);plot(t,y19);title('y19= y11+y12+y13+y14+y15+y16+y17+y18');
```



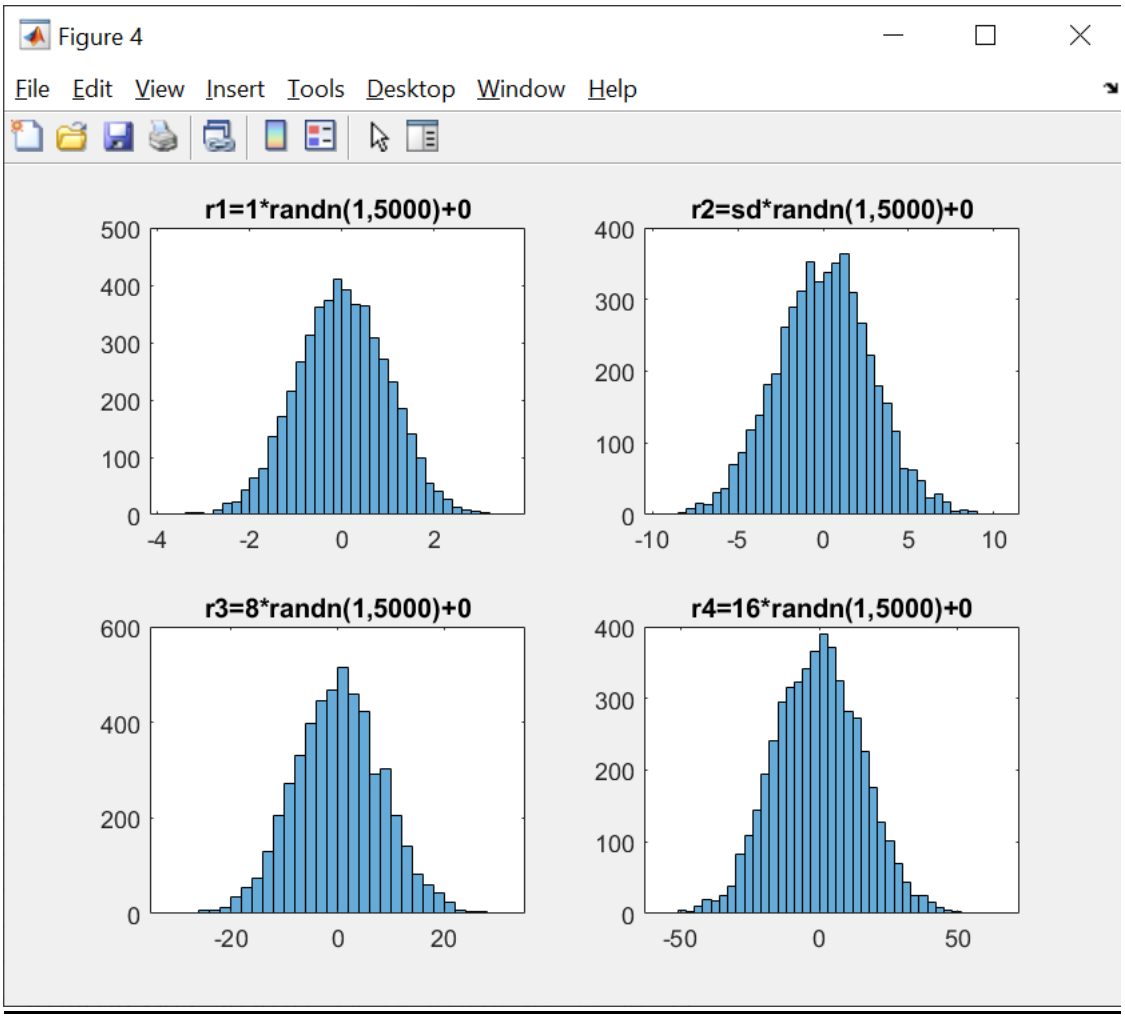
PROBLEM 3

```
%PROBLEM 3
figure;
z=rand(1,401)*0.1;
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+24+25+26+27+y28;
subplot(5,2,1);plot(t,y20);title('y20= z');
subplot(5,2,2);plot(t,y21);title('y21 = z+t');
subplot(5,2,3);plot(t,y22);title('y22= z+y1');
subplot(5,2,4);plot(t,y23);title('y23= z.*y1');
subplot(5,2,5);plot(t,y24);title('y24=t.*sin(2*pi*z)');
subplot(5,2,6);plot(t,y25);title('y25= sin(2*pi*(t+z))');
subplot(5,2,7);plot(t,y26);title('y26= z.*y2');
subplot(5,2,8);plot(t,y27);title('y27= sin(2*pi*(t+10*z))');
subplot(5,2,9);plot(t,y28);title('y28=y1./z');
subplot(5,2,10);plot(t,y29);title('y29= y21+y22+y23+24+25+26+27+y28');
```



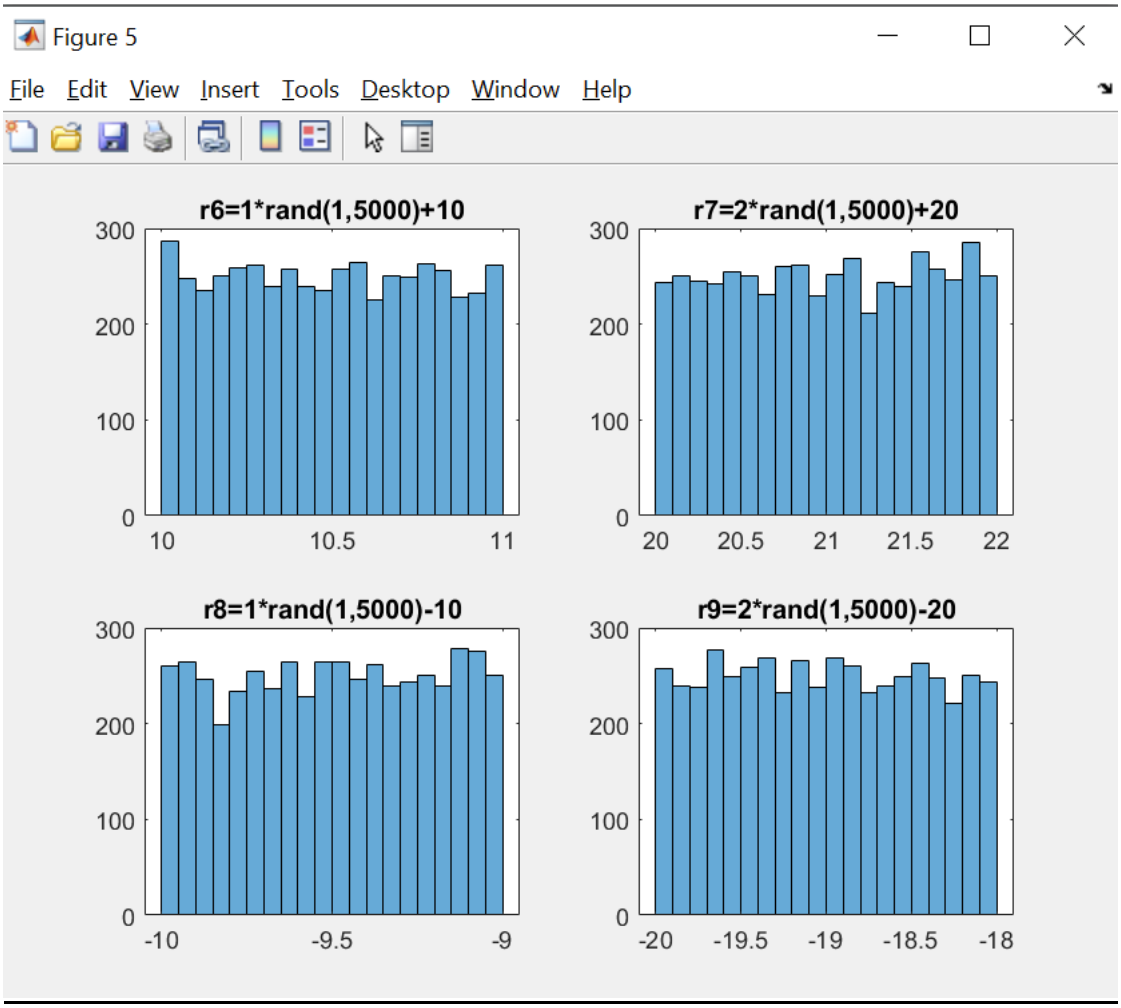
PROBLEM 4

```
72      %PROBLEM 4
73 -    figure;
74      %Starting with z (0,1) Gaussian(Normal) Random variable.
75      %Generate 5000 random variables with mean 0, variance 1; call it r1 vector
76 -    r1=1*randn(1,5000)+0;
77      %Generate 5000 random variables with mean 0, variance 8; call it r2 vector
78 -    sd = sqrt(8); % standard deviation
79 -    r2=sd*randn(1,5000)+0; % .* ?
80      %Generate 5000 random variables with mean 0, variance 64; call it r3 vector
81 -    r3=8*randn(1,5000)+0;
82      %Generate 5000 random variables with mean 0, variance 256; call it r4 vector
83 -    r4=16*randn(1,5000)+0;
84 -    subplot(2,2,1);histogram(r1);title('r1=1*randn(1,5000)+0');
85 -    subplot(2,2,2);histogram(r2);title('r2=sd*randn(1,5000)+0');
86 -    subplot(2,2,3);histogram(r3);title('r3=8*randn(1,5000)+0');
87 -    subplot(2,2,4);histogram(r4);title('r4=16*randn(1,5000)+0');
```



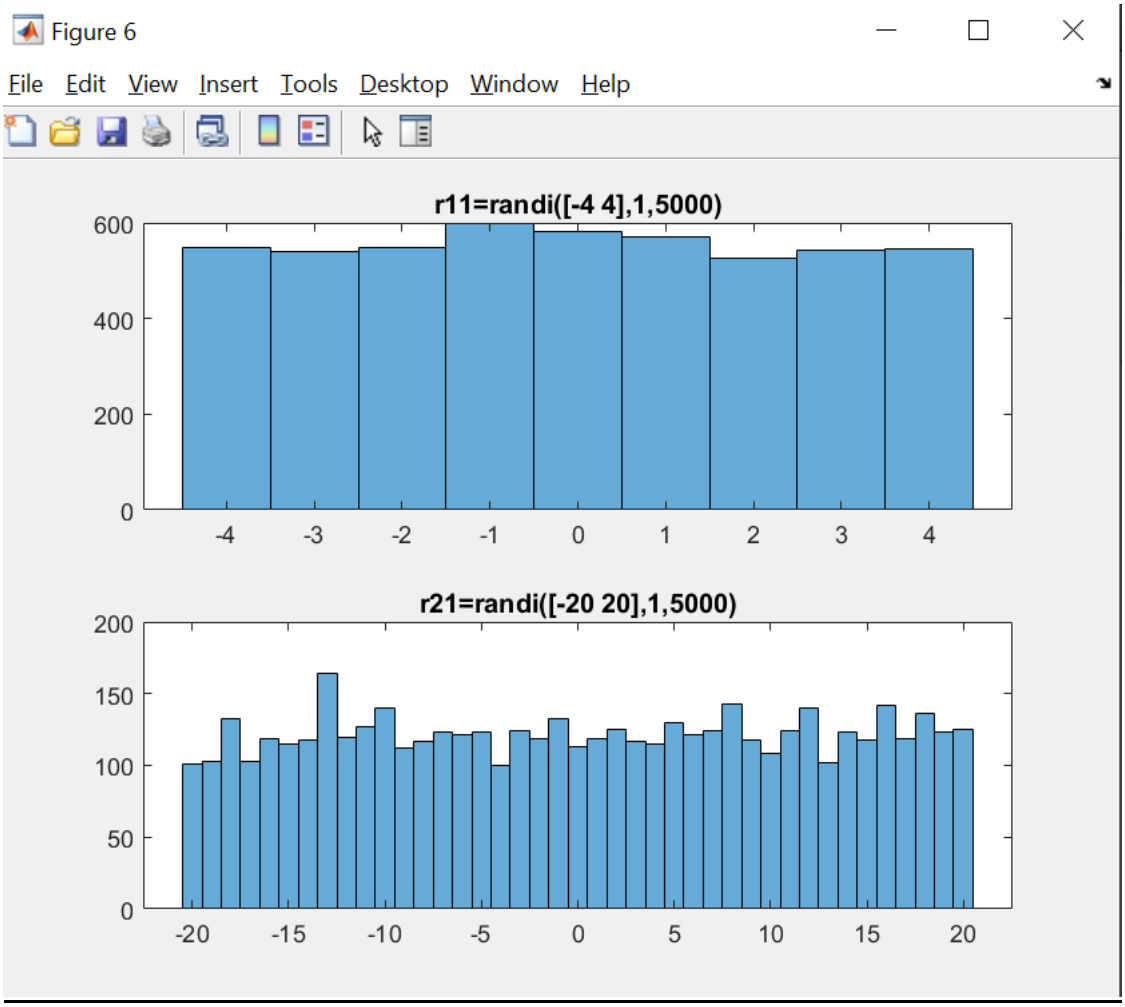
PROBLEM 5

```
91      %PROBLEM 5
92 -    figure;
93      %Starting with z (0,1) Gaussian Random variable.
94      %Generate 5000 random variables with mean 10, variance 1; call it r6 vector
95 -    r6=1*rand(1,5000)+10;
96      %Generate 5000 random variables with mean 20, variance 4; call it r7 vector
97 -    r7=2*rand(1,5000)+20;
98      %Generate 5000 random variables with mean -10, variance 1; call it r8 vector
99 -    r8=1*rand(1,5000)-10;
100     %Generate 5000 random variables with mean -20, variance 4; call it r9 vector
101 -   r9=2*rand(1,5000)-20;
102 -   subplot(2,2,1);histogram(r6);title('r6=1*rand(1,5000)+10');
103 -   subplot(2,2,2);histogram(r7);title('r7=2*rand(1,5000)+20');
104 -   subplot(2,2,3);histogram(r8);title('r8=1*rand(1,5000)-10');
105 -   subplot(2,2,4);histogram(r9);title('r9=2*rand(1,5000)-20');
```



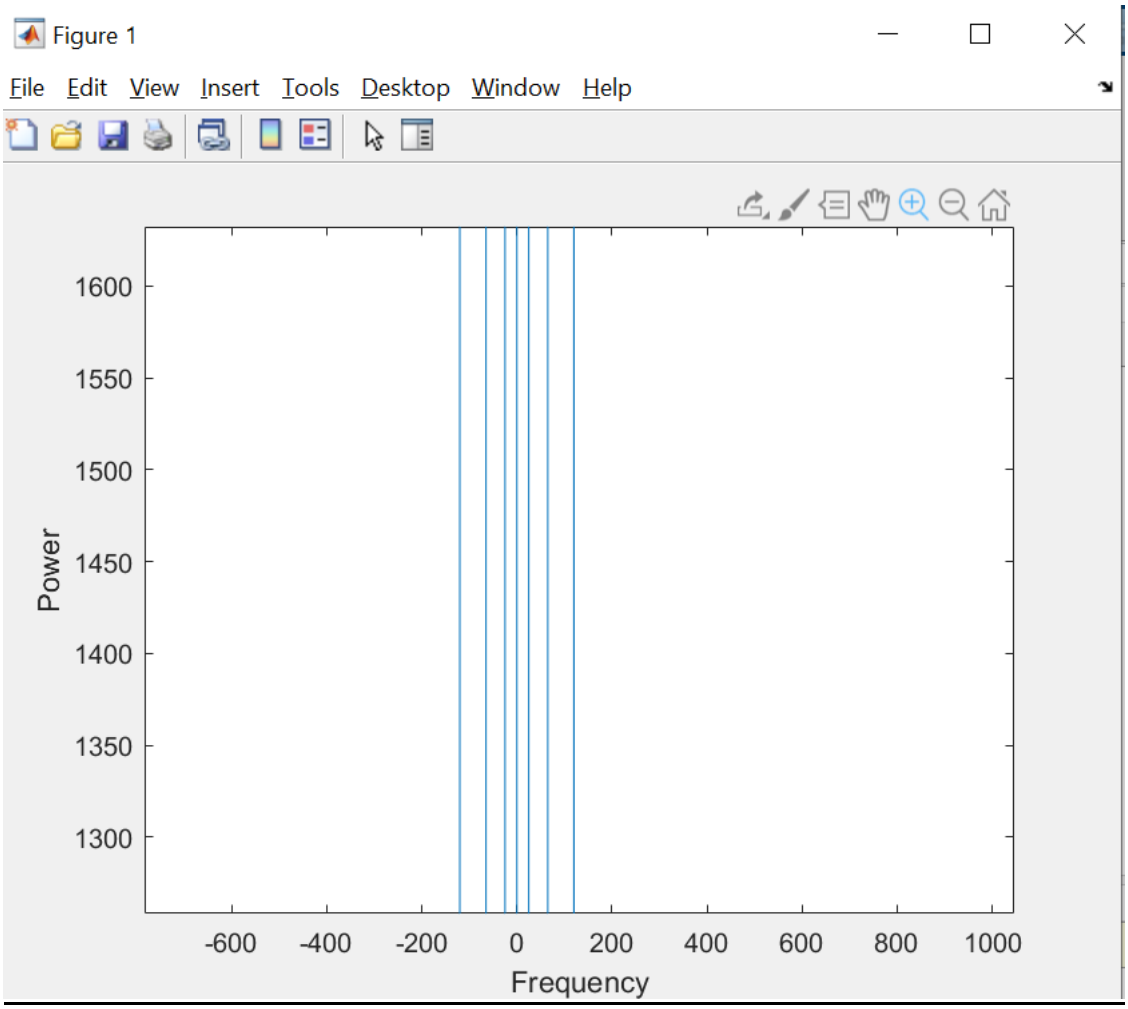
PROBLEM 6

```
108     %PROBLEM 6
109 -   figure;
110     %Starting with z uniformly distributed random variable.
111     %Generate 5000 random variables with between -4 and 4; call it r11 vector
112 -   r11=randi([-4 4],1,5000);
113     %Generate 5000 random variables with between -20 and 20; call it r21 vector
114 -   r21=randi([-20 20],1,5000);
115 -   subplot(2,1,1);histogram(r11);title('r11=randi([-4 4],1,5000)');
116 -   subplot(2,1,2);histogram(r21);title('r21=randi([-20 20],1,5000)');
```



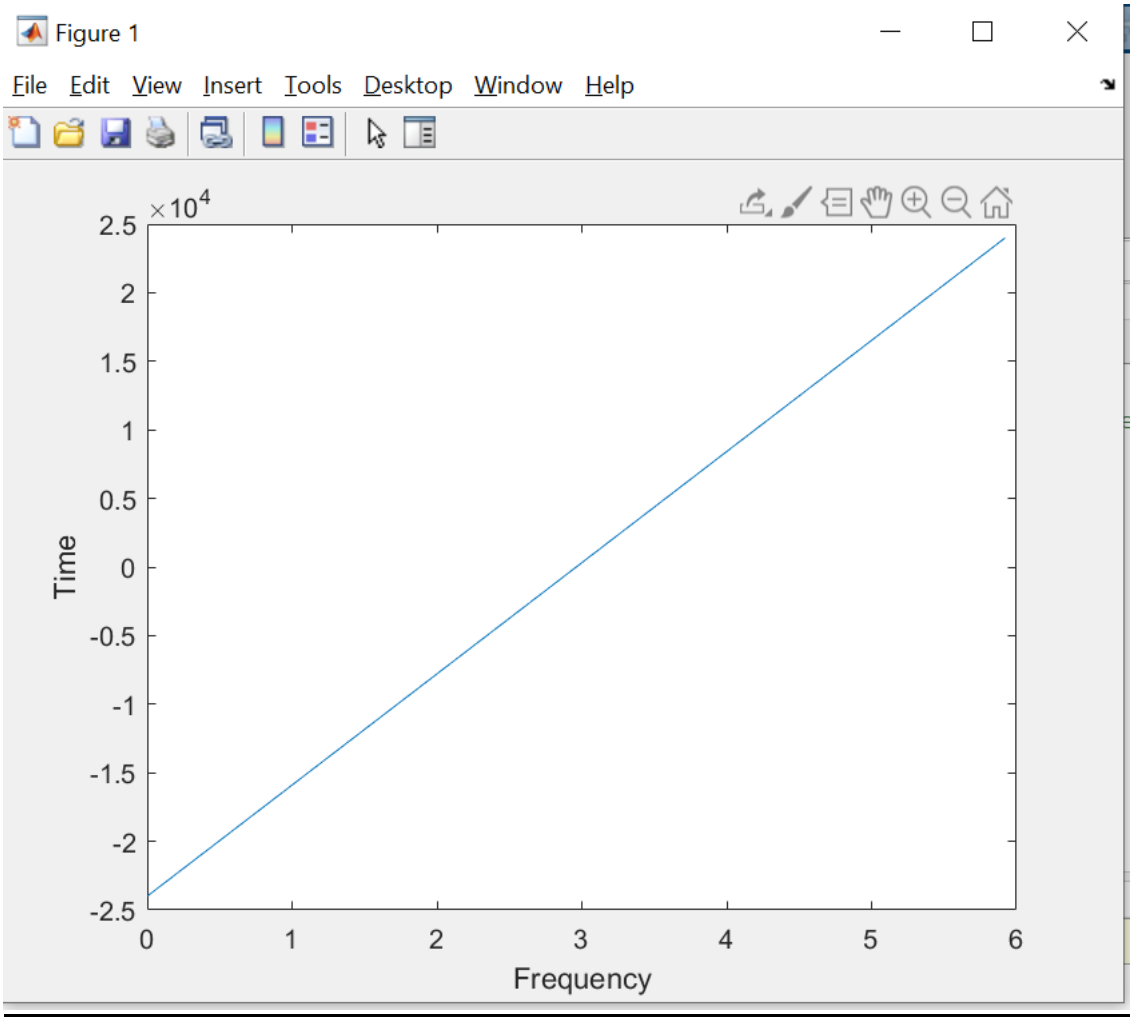
PROBLEM 7

```
1    %PROBLEM 7
2 -  filename = 'mysignal.mat';
3 -  load(filename);
4 -  Y = fft(x);
5 -  l=length(x);
6 -  Y0 = fftshift(Y);
7 -  f0 = (-l/2:l/2-1)*(fs/l); % 0-centered frequency range
8 -  power0 = abs(Y0).^2/l;    % 0-centered power
9 -  plot(f0,power0)
10 -  xlabel('Frequency')
11 -  ylabel('Power')
12 -  xlim([-5000 5000])
```



PROBLEM 8

```
%PROBLEM 8
[y,fs] = audioread('hw1-prob8.m4a'); %y=sampled data and Fs is the sampling rate
y1 = y(:,1);
y2 = y(:,2);
Y = fft(y1);
l=length(y1);
t=linspace(0,l/fs,l);
Y0 = fftshift(Y);          % shift y values
f0 = (-l/2:l/2-1)*(fs/l); % 0-centered frequency range
plot(t,f0)
ylabel('Time')
xlabel('Frequency')
```



PROBLEM 9

```
%PROBLEM 9
Image=imread('lena.png'); %Read the image
%imshow(Image);
GrayImage=rgb2gray(Image); %Convert rgb image into a grayscale image.
%imshow(Image);
mean=mean2(GrayImage); %Find mean of gray image
std=std2(GrayImage); %Find standart deviation
[maxValue, linearIndexesOfMax] = max(GrayImage(:)); %Find the maximum element of the image file and max index
% there can be the max value at more than one location so we use ind2subs function
[rowOfMax , colOfMax] = ind2sub(size(GrayImage), linearIndexesOfMax);%Find maximum row and column
[minValue, linearIndexesOfMin] = min(GrayImage(:)); %Find the minumum element of the image file and min index
[rowOfMin, colOfMin] = ind2sub(size(GrayImage), linearIndexesOfMin);%Find minimum row and column
%Display values
disp(['Mean:' num2str(mean)]);
disp(['Standard Deviation:' num2str(std)]);
disp(['Maximum value:' num2str(maxValue)]);
disp(['Maximum"s index:' num2str(linearIndexesOfMax)]);
disp(['Maximum"s row:' num2str(rowOfMax)]);
disp(['Maximum"s column: ' num2str(colOfMax)]);
disp(['Minimum value: ' num2str(minValue)]);
disp(['Minimum"s index: ' num2str(linearIndexesOfMin)]);
disp(['Minimum"s row: ' num2str(rowOfMin)]);
disp(['Minimum"s column: ' num2str(colOfMin)]);
```

```
>> prob9
Mean:124.0425
Standard Deviation:47.8556
Maximum value:245
Maximum"s index:202514
Maximum"s row:274
Maximum"s column: 396
Minimum value: 25
Minimum"s index: 1608
Minimum"s row: 72
Minimum"s column: 4
```