

CMPE362 - Spring '20 Homework 1 Report

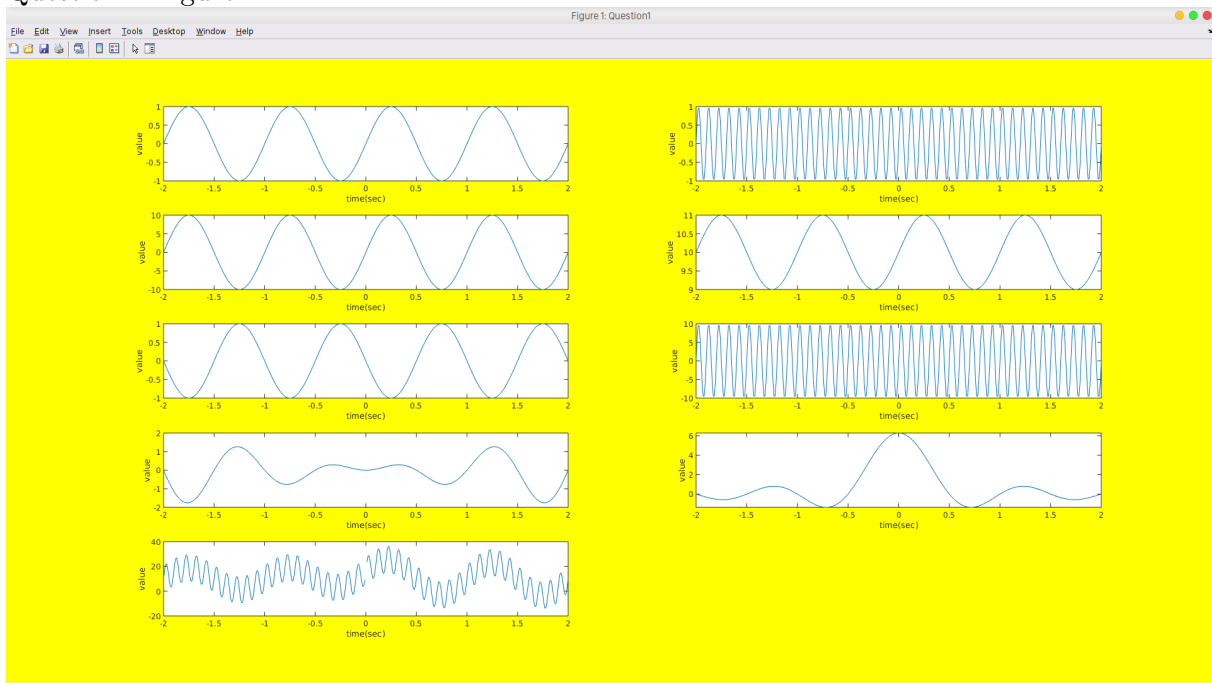
1. Question 1 - 6:

From questions 1 to 6, I've learned several matrix operations, plotting and figuring vector(s) or matrix(matrices) on screen. Working with great amount of data requires perfect visualization, the most efficient ways of manipulating data, and the best approach to store data.

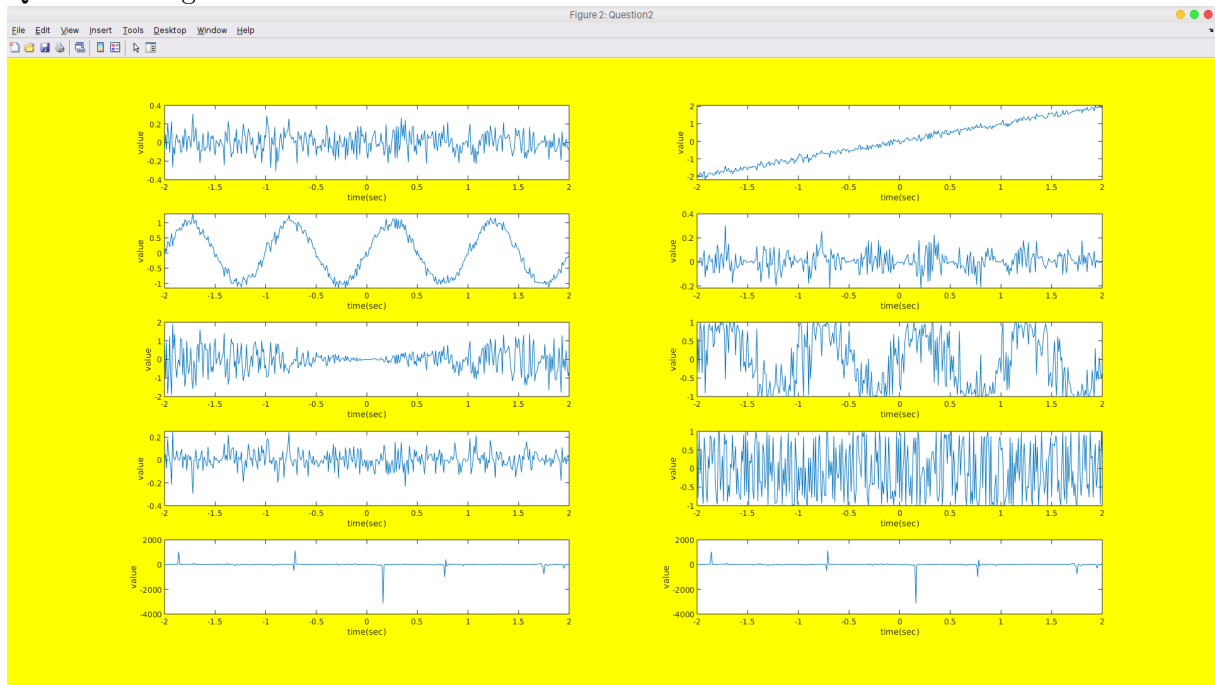
For visualization, I've learned how to illustrate several figures and several graphs into one figure. Adding labels for each dimension and setting plot/figure names are quite beneficial.

For matrix/vector operations, I've accustomed to do arithmetic operations on many vectors and matrices, by elementwise or by vector/matrixwise, whenever necessary. In addition to that, I've used sinusoidal functions and refreshed my knowledge of sinusoidal functions.

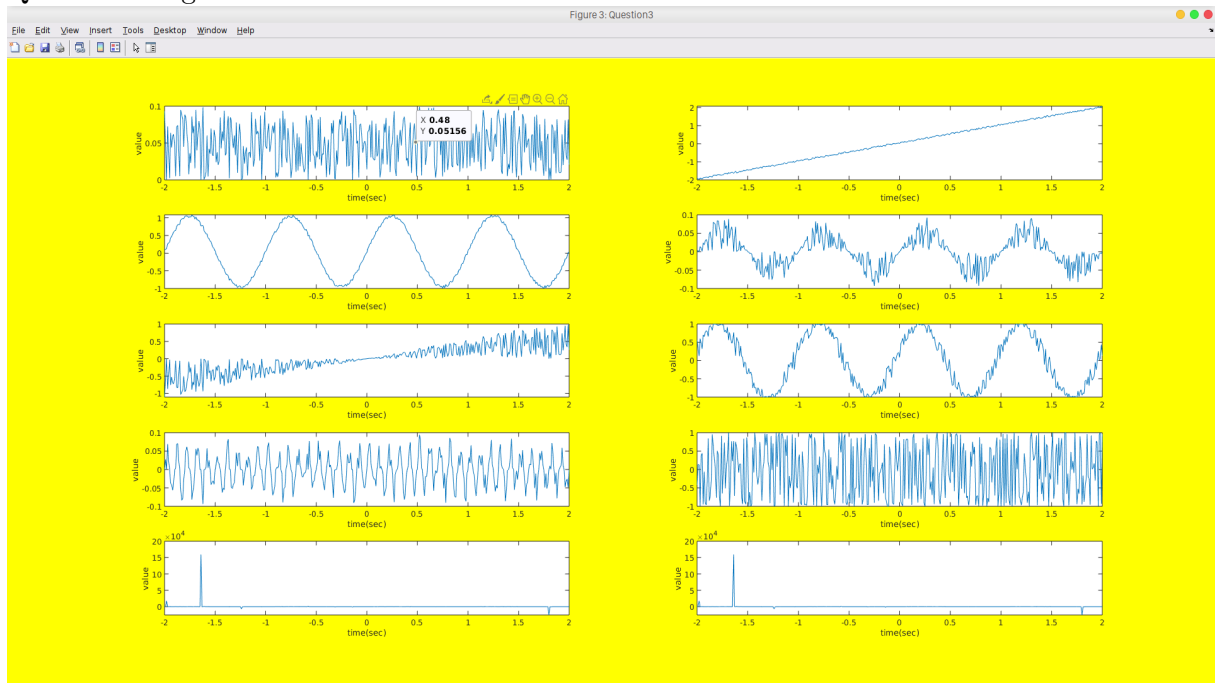
- Question 1 Figure:



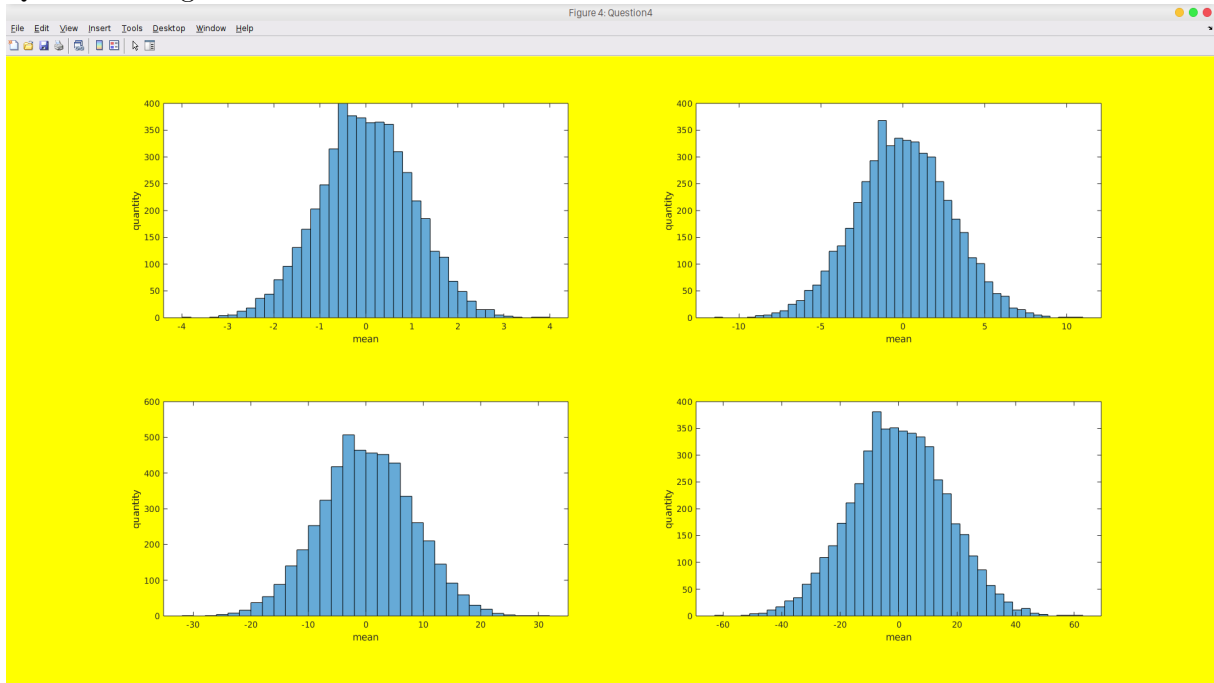
- Question 2 Figure:



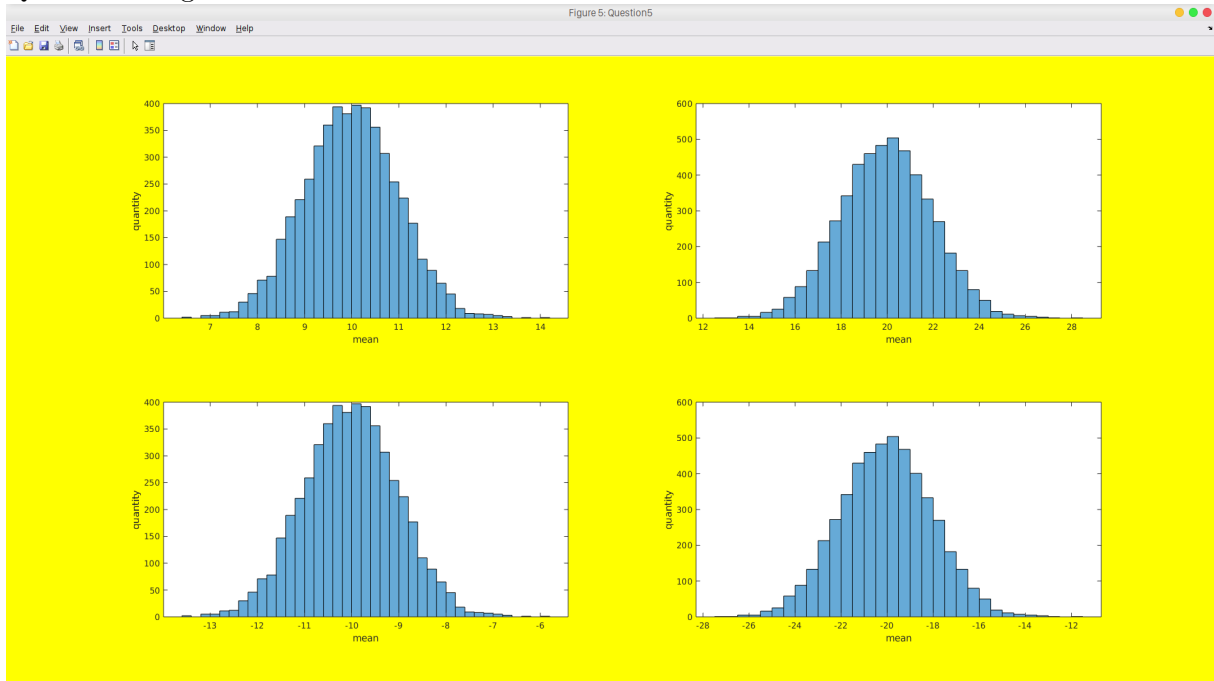
- Question 3 Figure:



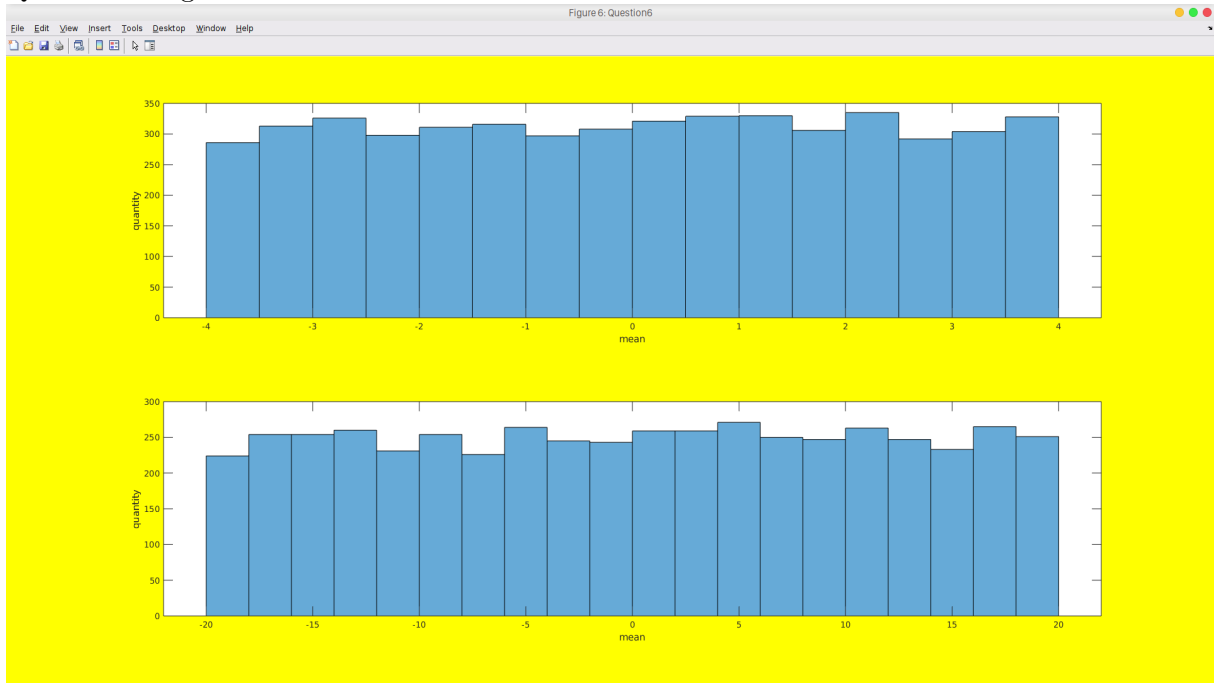
- Question 4 Figure:



- Question 5 Figure:



- Question 6 Figure:



2. Question 7:

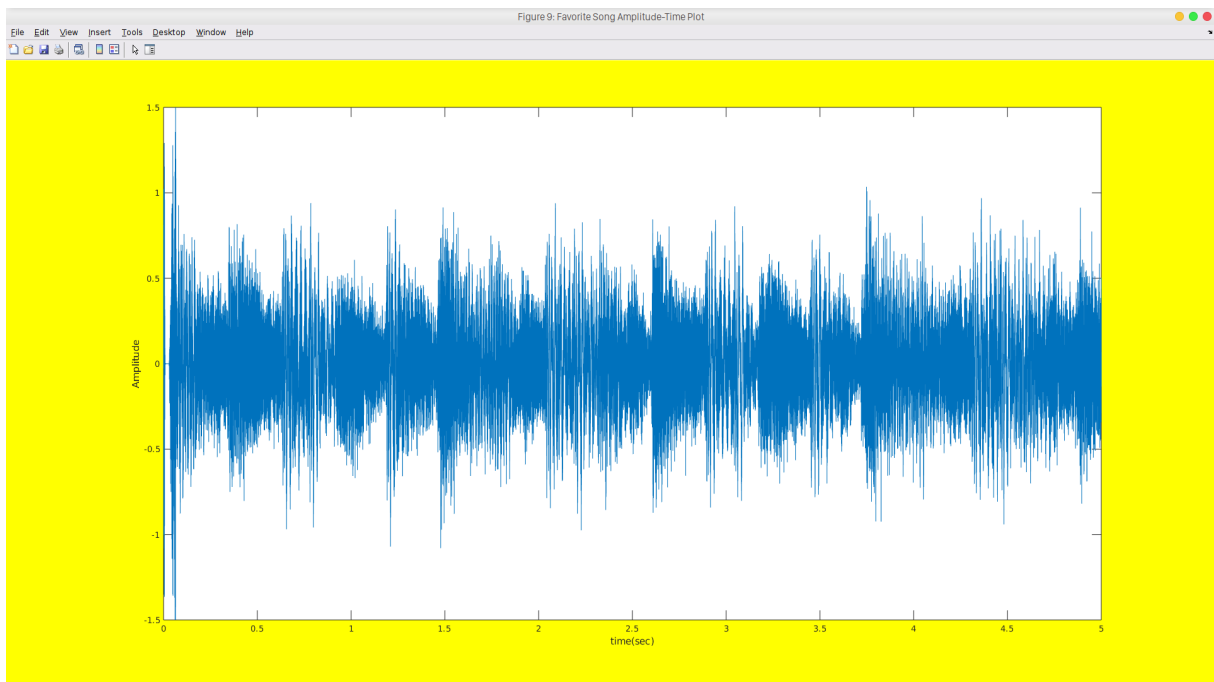
The function of the signal given as 'mysignal.mat' file is below:

$$x(t) = 2167 + 4334\cos(50 \cdot \pi \cdot t) + 4334\cos(130 \cdot \pi \cdot t) + 4334\cos(240 \cdot \pi \cdot t)$$

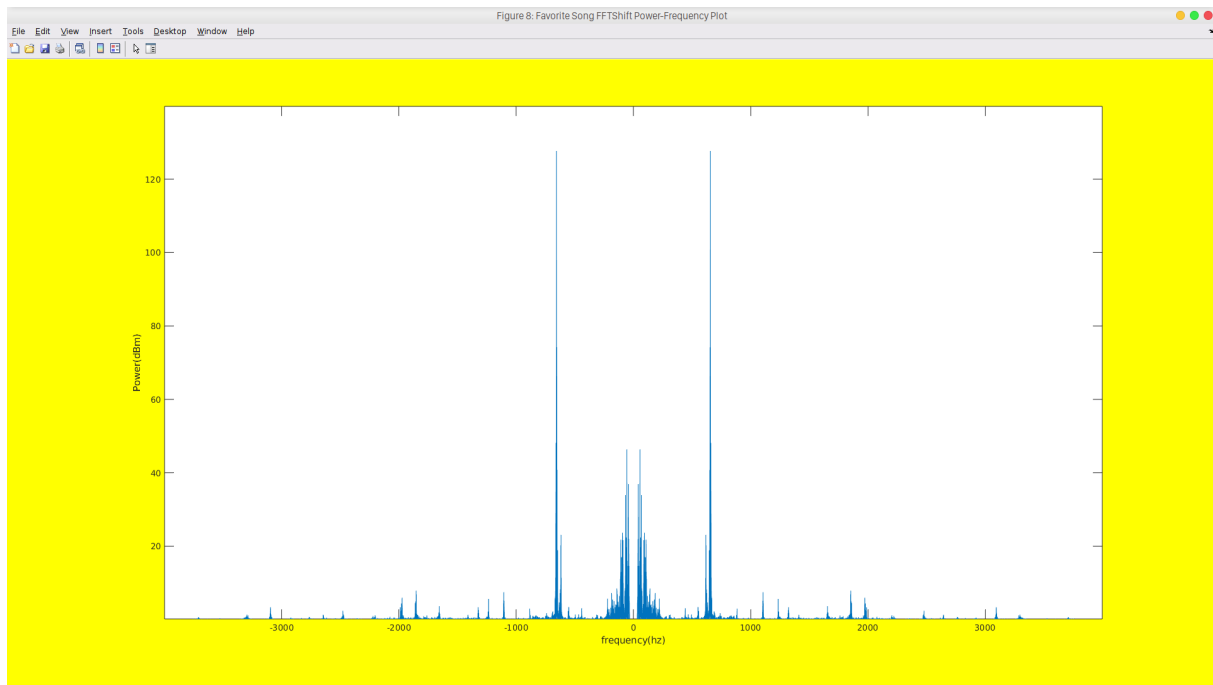
3. Question 8:

For the song Anastasia(Slash ft. Myles Kennedy) between 45.5 and 50.5 seconds, the graphs of frequency and time are below:

- Time-Amplitude Graph:



- Frequency-Power Graph:



4. Question 9:

The requested values are written below:

Mean: 124.0425

Standard deviation: 47.8556

Minimum element value: 25

Minimum element position(row, column): 72 4

Maximum element value: 245

Maximum element position(row, column): 274 396

5. Code of HW1_firstpart:

```
1 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
2 % Problem 1%
3 t = (-2:0.01:2);
4 y1 = sin(2*pi*t);
5 y2 = sin(2*pi*t*10);
6 y3 = 10*sin(2*pi*t);
7 y4 = sin(2*pi*t)+10;
8 y5 = sin(2*pi*(t-0.5));
9 y6 = 10*sin(2*pi*t*10);
10 y7 = t.*sin(2*pi*t);
11 y8 = sin(2*pi*t) ./ t;
12 y9 = y1 + y2 + y3 + y4 + y5 + y6 + y7 + y8;
13 figure('Name', 'Question1', 'Color', 'Yellow');
14 subplot(5,2,1), plot(t, y1);
15 xlabel('time(sec)');
16 ylabel('value');
17 subplot(5,2,2), plot(t, y2);
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18 xlabel('time(sec)');
19 ylabel('value');
20 subplot(5,2,3), plot(t, y3);
21 xlabel('time(sec)');
22 ylabel('value');
23 subplot(5,2,4), plot(t, y4);
24 xlabel('time(sec)');
25 ylabel('value');
26 subplot(5,2,5), plot(t, y5);
27 xlabel('time(sec)');
28 ylabel('value');
29 subplot(5,2,6), plot(t, y6);
30 xlabel('time(sec)');
31 ylabel('value');
32 subplot(5,2,7), plot(t, y7);
33 xlabel('time(sec)');
34 ylabel('value');
35 subplot(5,2,8), plot(t, y8);
36 xlabel('time(sec)');
37 ylabel('value');
38 subplot(5,2,9), plot(t, y9);
39 xlabel('time(sec)');
40 ylabel('value');
41 % Problem 1 Ending %
42 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
43 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
44 % Problem 2 %
45 rand_vector1 = randn(1,401);
46 z = rand_vector1 .* 0.1;
47 y10 = z;
48 y11 = z + t;
49 y12 = z + y1;
50 y13 = z .* y1;
51 y14 = t .* sin(2 * pi .* z);
52 y15 = sin(2 * pi * (t + z));
53 y16 = z .* y2;
54 y17 = sin(2 * pi * (t + 10 .* z));
55 y18 = y1 ./ z;
56 y19 = y11 + y12 + y13 + y14 + y15 + y16 + y17 + y18;
57 figure('Name', 'Question2', 'Color', 'Yellow');
58 subplot(5,2,1), plot(t, y10);
59 xlabel('time(sec)');
60 ylabel('value');
61 subplot(5,2,2), plot(t, y11);
62 xlabel('time(sec)');
63 ylabel('value');
64 subplot(5,2,3), plot(t, y12);
65 xlabel('time(sec)');
66 ylabel('value');
67 subplot(5,2,4), plot(t, y13);
68 xlabel('time(sec)');
69 ylabel('value');
70 subplot(5,2,5), plot(t, y14);
71 xlabel('time(sec)');

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72 ylabel('value');
73 subplot(5,2,6), plot(t, y15);
74 xlabel('time(sec)');
75 ylabel('value');
76 subplot(5,2,7), plot(t, y16);
77 xlabel('time(sec)');
78 ylabel('value');
79 subplot(5,2,8), plot(t, y17);
80 xlabel('time(sec)');
81 ylabel('value');
82 subplot(5,2,9), plot(t, y18);
83 xlabel('time(sec)');
84 ylabel('value');
85 subplot(5,2,10), plot(t, y19);
86 xlabel('time(sec)');
87 ylabel('value');
88 % Problem 2 Ending %
89 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
90 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
91 % Problem 3 %
92 rand_vector2 = rand(1, 401);
93 z = rand_vector2 .* 0.1;
94 y20 = z;
95 y21 = z + t;
96 y22 = z + y1;
97 y23 = z .* y1;
98 y24 = t .* sin(2 * pi * z);
99 y25 = sin(2 * pi * (t + z));
100 y26 = z .* y2;
101 y27 = sin(2 * pi * (t + 10 .* z));
102 y28 = y1 ./ z;
103 y29 = y21 + y22 + y23 + y24 + y25 + y26 + y27 + y28;
104 figure('Name', 'Question3', 'Color', 'Yellow');
105 subplot(5,2,1), plot(t, y20);
106 xlabel('time(sec)');
107 ylabel('value');
108 subplot(5,2,2), plot(t, y21);
109 xlabel('time(sec)');
110 ylabel('value');
111 subplot(5,2,3), plot(t, y22);
112 xlabel('time(sec)');
113 ylabel('value');
114 subplot(5,2,4), plot(t, y23);
115 xlabel('time(sec)');
116 ylabel('value');
117 subplot(5,2,5), plot(t, y24);
118 xlabel('time(sec)');
119 ylabel('value');
120 subplot(5,2,6), plot(t, y25);
121 xlabel('time(sec)');
122 ylabel('value');
123 subplot(5,2,7), plot(t, y26);
124 xlabel('time(sec)');
125 ylabel('value');

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126 subplot(5,2,8), plot(t, y27);
127 xlabel('time(sec)');
128 ylabel('value');
129 subplot(5,2,9), plot(t, y28);
130 xlabel('time(sec)');
131 ylabel('value');
132 subplot(5,2,10), plot(t, y29);
133 xlabel('time(sec)');
134 ylabel('value');
135 % Problem 3 Ending %
136 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
137 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
138 % Problem 4 %
139 rand_vector3 = randn(1, 5000);
140 r1 = rand_vector3;
141 r2 = sqrt(8) .* rand_vector3;
142 r3 = sqrt(64) .* rand_vector3;
143 r4 = sqrt(256) .* rand_vector3;
144 figure('Name', 'Question4', 'Color', 'Yellow');
145 subplot(2,2,1), histogram(r1);
146 xlabel('mean');
147 ylabel('quantity');
148 subplot(2,2,2), histogram(r2);
149 xlabel('mean');
150 ylabel('quantity');
151 subplot(2,2,3), histogram(r3);
152 xlabel('mean');
153 ylabel('quantity');
154 subplot(2,2,4), histogram(r4);
155 xlabel('mean');
156 ylabel('quantity');
157 % Problem 4 Ending %
158 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
159 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
160 % Problem 5 %
161 rand_vector3 = randn(1, 5000);
162 r6 = 10 + rand_vector3;
163 r7 = 20 + sqrt(4) .* rand_vector3;
164 r8 = -10 + rand_vector3;
165 r9 = -20 + sqrt(4) .* rand_vector3;
166 figure('Name', 'Question5', 'Color', 'Yellow');
167 subplot(2,2,1), histogram(r6);
168 xlabel('mean');
169 ylabel('quantity');
170 subplot(2,2,2), histogram(r7);
171 xlabel('mean');
172 ylabel('quantity');
173 subplot(2,2,3), histogram(r8);
174 xlabel('mean');
175 ylabel('quantity');
176 subplot(2,2,4), histogram(r9);
177 xlabel('mean');
178 ylabel('quantity');
179 % Problem 5 Ending %

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180 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
181 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
182 % Problem 6 %
183 rand_vector4 = rand(1, 5000);
184 r11 = -4 + 8 .* rand_vector4;
185 r21 = -20 + 40 .* rand_vector4;
186 figure('Name', 'Question6', 'Color', 'Yellow');
187 subplot(2,1,1), histogram(r11);
188 xlabel('mean');
189 ylabel('quantity');
190 subplot(2,1,2), histogram(r21);
191 xlabel('mean');
192 ylabel('quantity');
193 % Problem 6 Ending %
194 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

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6. Code of HW1_secondpart:

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1 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
2 % Problem 7 %
3 mysignal = load('mysignal.mat'); %loaded the audio data
4 fftY = fft(mysignal.x); % converted raw data via 'Discrete Fast Fourier
   Transform'
5 fftshiftY = fftshift(fftY); % shifted the base value to show the negative
   parts and the positive parts of the signal as counterparts
6 n = length(mysignal.x); % found the sample size
7 f = (-n/2:n/2-1) * (mysignal.fs/n); % created the symmetric frequency axis
   to plot
8 power = (abs(fftshiftY) .^2) / n; % took the normalized power of signal
9 figure('Name', 'Question7', 'Color', 'Yellow');
10 plot(f, power); % plot the signal via freq-power tuples
11 xlabel('frequency(hz)');
12 ylabel('power(mW)');
13 % Problem 7 Ending %
14 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
15 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
16 % Problem 8 %
17 [favSong, fs] = audioread('slash.mp3'); % loaded the favsong
18 favSongData = favSong(:,1) + favSong(:,2) ./ 2; % since it is a stereo
   recorded song, I've taken the average of different signal layers.
19 n = length(favSongData); % found the sample size
20 favSongFFT = fft(favSongData); % transformed data under 'Discrete Fast
   Fourier Transform'
21 favSongFFTShift = fftshift(favSongFFT); % shifted the FFT data to show the
   counterparts of each signal
22 f = (-n/2:n/2-1) * (fs/n); % created the symmetric frequency axis
23 time = (0:5/n:5-5/n); % created the time axis
24 power = abs(favSongFFTShift) .^2 / n; % took the normalized power of the
   signal
25 figure('Name', 'Favorite Song FFTShift Power-Frequency Plot', 'Color', '
   Yellow');
26 plot(f, power); % plotted the freq-power graph
27 xlabel('frequency(hz)');

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28 ylabel('Power(dBm)');
29 figure('Name', 'Favorite Song Amplitude-Time Plot', 'Color', 'Yellow');
30 plot(time, favSongData); % plotted the time-amplitude graph
31 xlabel('time(sec)');
32 ylabel('Amplitude');
33 % Problem 8 Ending %
34 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
35 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
36 % Problem 9 %
37 lena_transform = imread('lena.png'); % read the image as 3D matrix with RGB
    values.
38 lena_gray_transform = rgb2gray(lena_transform); % transformed each RGB value
    into single grayscale value.
39 lena_mean = mean(lena_gray_transform, 'all'); % took the mean of grayscale
    matrix
40 disp("Mean: " + lena_mean);
41 lena_gray_array = double(lena_gray_transform(:));
42 lena_standard_deviation = std(lena_gray_array);
43 disp("Standard deviation: " + lena_standard_deviation);
44 [MIN, INMIN] = min(lena_gray_transform); % found the minimum value of each
    column and its indexes
45 [min, inmin] = min(MIN); % found the overall minimum value and its index
46 disp("Minimum element value: " + min);
47 disp("Minimum element position(row, column): " + INMIN(inmin) + " " + inmin)
    ;
48 [MAX, INMAX] = max(lena_gray_transform); % found the maximum value of each
    column and its indexes
49 [max, inmax] = max(MAX); % found the overall maximum value and its index
50 disp("Maximum element value: " + max);
51 disp("Maximum element position(row, column): " + INMAX(inmax) + " " + inmax)
    ;
52 % Problem 9 Ending %
53 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

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References:

- For Question 7, I've read the article below:
<https://www.mathworks.com/help/matlab/math/basic-spectral-analysis.html>
- For Question 8, I've read the article below:
<https://www.mathworks.com/help/matlab/ref/audioread.html>
- For Question 9, I've read the article below:
<https://www.mathworks.com/help/matlab/ref/std.html>