# MATLAB Assignment #2

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# Preparation

For this assignment I have utilized example 7.5-3 as a reference to complete this project. I have adjusted the values and parameters of the example to conform with the function given in the question and to correctly graph both the Autocorrelation and Power Spectrum.

In the given problem the variance for x is given as 5 whenever k = 0. Additionally, for the new sequence the third term is found to be a factor of $\frac{1}{5}$ instead of $\frac{1}{4}$. After adjusting for the values both the autocorrelation and spectrum graphs do not differ much from the original example.

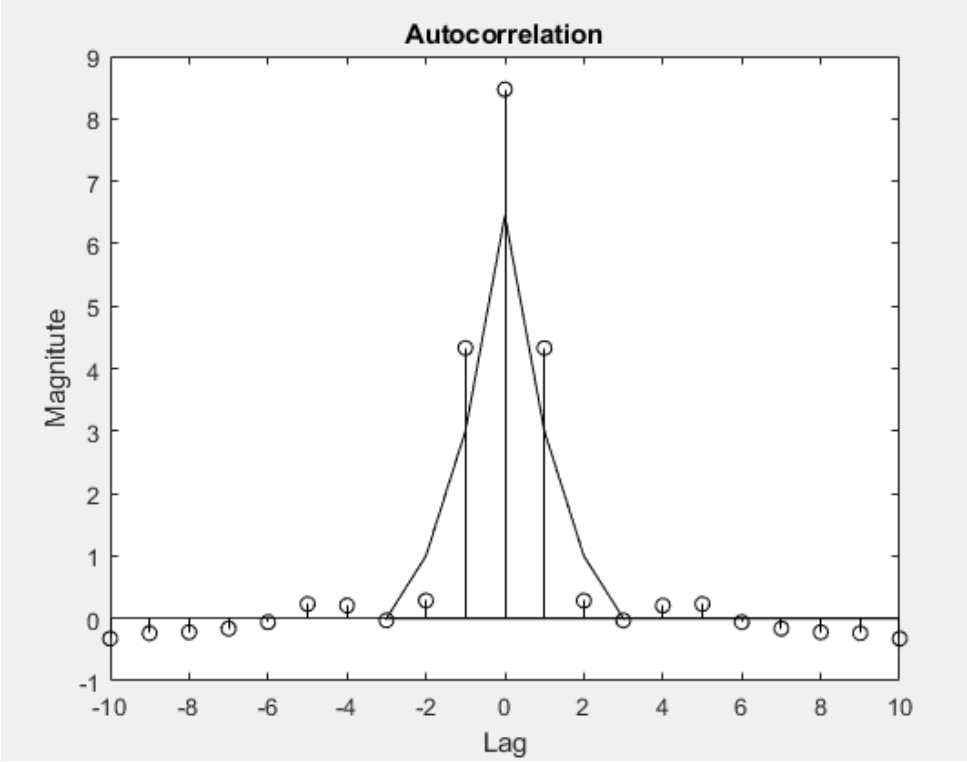
I've have included all of the code along with the graphs below.

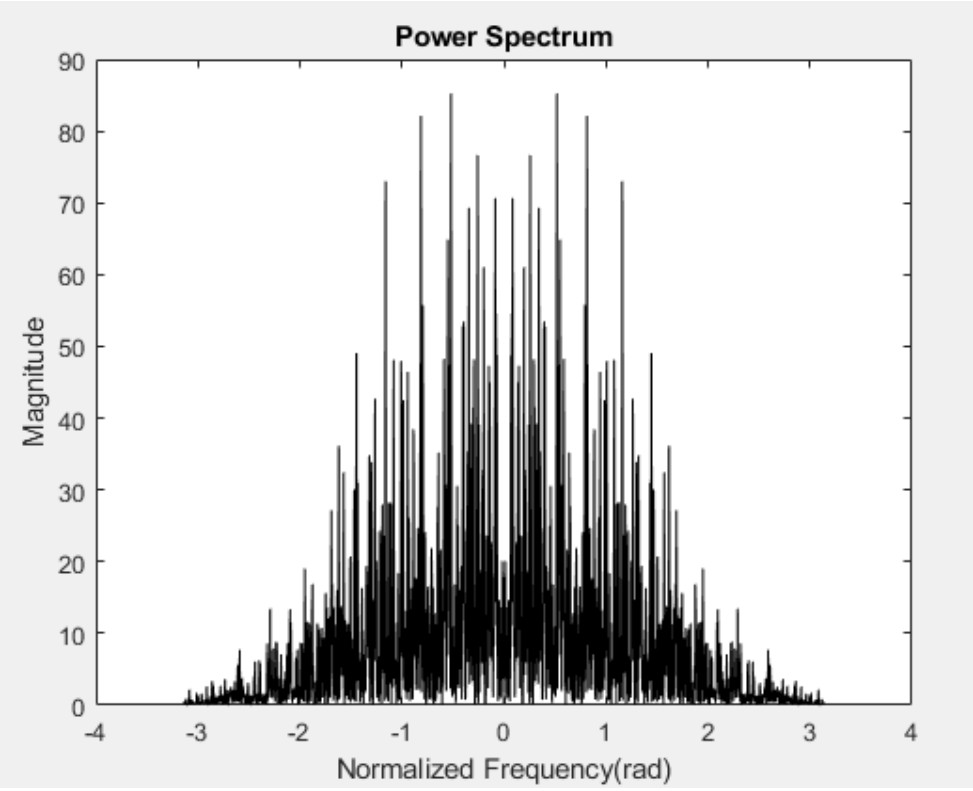
# Code

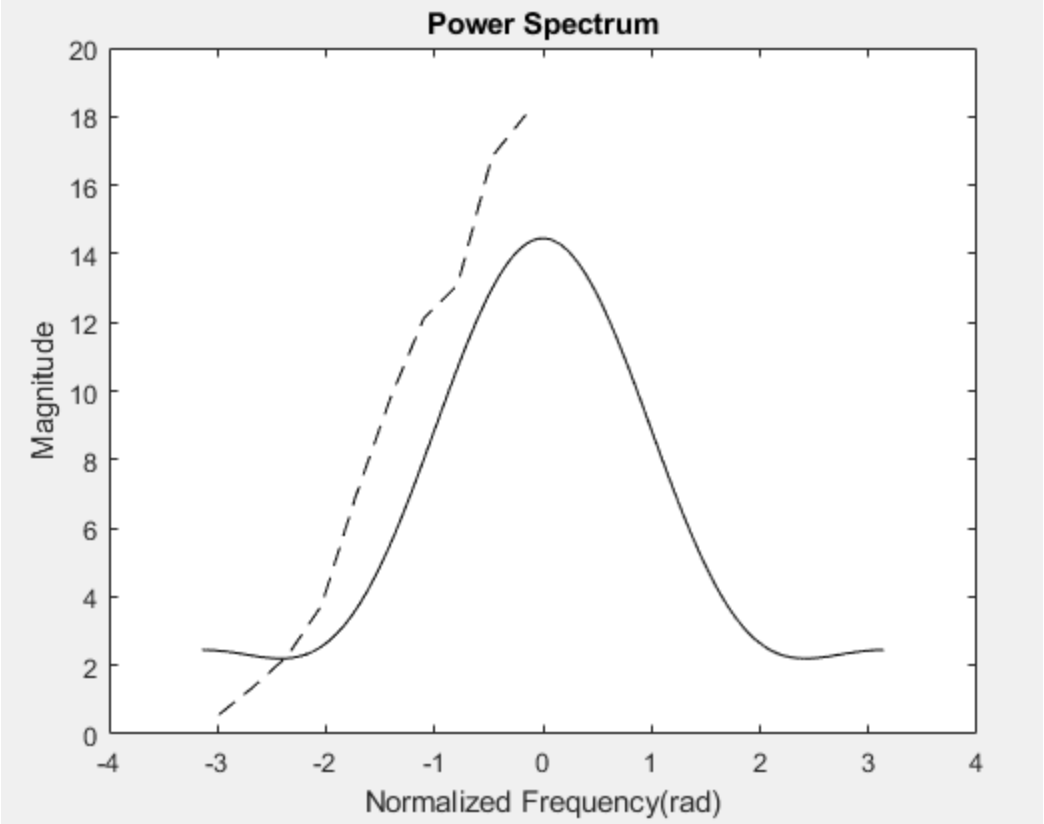
```
clear

N = 1000;
xvar = 5; %variance of x (CHANGED VARIANCE GIVEN THE PROBLEM)
lag = 10;

randn('state',140);
x = sqrt(xvar)*randn(1, N+2); %i.i.d. Gaussian random variable

xn = x(3:N+2); %x(n)
xn1 = x(2:N+1); %x(n-1)
xn2 = xn1(1:N); %x(n-2)

y = xn + 0.5*xn1 + 0.2*xn2;

Ryy = zeros(1,2*N-1); %initialize

for k = -N+1:N-1
    ndx1 = max([1 1+k]) :min([N+k N]);
    ndx2 = max([1 1-k]) :min([N-k N]);
    Ryy(N+k) = sum(y(ndx1).*y(ndx2))./N; %autocorrelation
end

Rtrue = xvar*[0 0 1/5 3/5 129/100 3/5 1/5 0 0]; %true value of Ryy

M = 2*N-1;
w = -pi+pi/M:2*pi/M:pi; %frequency vector

Strue = xvar*((129/100)+(6/5)*cos(w)+(2/5)*cos(2*w));%true value of Syy
Syy_noisy = abs(fftshift(fft(Ryy))); %power spectral estimate

stp=100; %number of points to average
Syy = zeros(1,(M+1)/stp);

for i = 1:stp:M %smooth power spectrum estimate
    if i<(M+1)/2
        Syy((i-1)/stp+1) = mean(Syy_noisy(i:i+stp-1));
    else
        Syy((i-1)/stp+1) = mean(Syy_noisy(i-1:1+stp-2));
    end
end

clf
plot ([lag -3:3 lag], Rtrue, 'k')
hold
stem(-lag:lag,Ryy(N-lag:N+lag),'k')

xlabel('Lag')
ylabel('Magnitute')
title('Autocorrelation')
```

```
figure
plot(w,Syy_noisy(1:M),'k')
xlabel('Normalized Frequency(rad)')
ylabel('Magnitude')
title('Power Spectrum')

figure
plot(w(round(stp/2):stp:length(w)),Syy,'--k',w,Strue,'k')
xlabel('Normalized Frequency(rad)')
ylabel('Magnitude')
title('Power Spectrum')
```

## Graphs


Autocorrelation
Magnitute
Lag
9
8
7
6
5
4
3
2
1
0
-1
-10
-8
-6
-4
-2
0
2
4
6
8
10


Power Spectrum
Magnitude
Normalized Frequency(rad)
90
80
70
60
50
40
30
20
10
0
-4
-3
-2
-1
0
1
2
3
4


Power Spectrum
Magnitude
Normalized Frequency(rad)
0
2
4
6
8
10
12
14
16
18
20
-4
-3
-2
-1
0
1
2
3
4