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Hw1 - Q6

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```
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% University: Amirkabir University of Technology
```

clear recent data

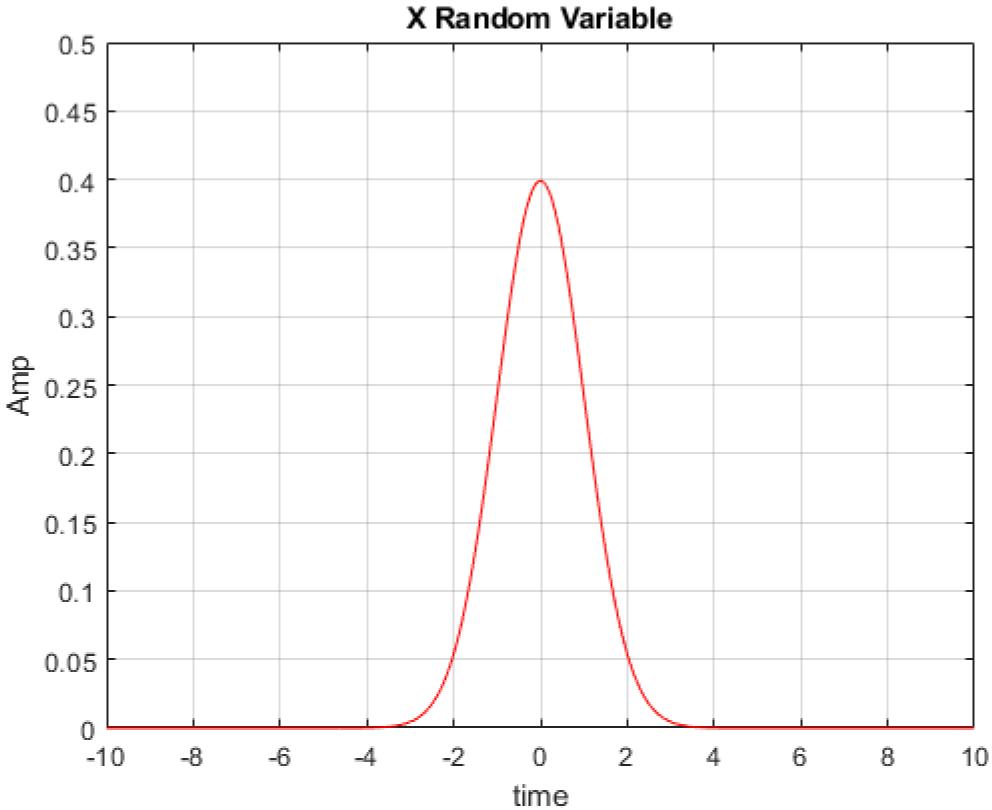
```
clc;
close all;
clear ;
```

Initialization

```
res = 0.01 ; %resolution
t = -10 : res : 10 - res ;%time
m = 0 ; %mean
sigma = 1 ; %unit variance
x = normal(t,m,sigma) ; %Gaussian Random Variable
a = [-5,-4,-2,0,1,3,5]; %boundries of region
N = numel(a) + 1 ;%quantization evels
a = [-10,-5,-4,-2,0,1,3,5,10]; %boundries of region
```

plotting m(t)

```
clc;
figure(1)
plot(t,x,'r')
hold on;
ylabel("Amp")
xlabel("time")
title("X Random Variable")
grid on;
axis([-10 10 0 0.5])
```



calcuation of codebooks

```
clc;
pdf = 'exp(-(x-m).^2/2/sigma^2)/sqrt(2*pi)/sigma'; %Gaussian pdf of x
xf = inline(['x.*' pdf],'x','m','sigma');%Pdf of x*fX(x)
f = inline(pdf,'x','m','sigma');%Pdf of fX(x)
b0 = 0 ; %min of signal
bN = max(x) ; %max of signal
delta=(bN-b0)/N; %interval between codebooks
msqe=0; % Mean-Square Quantization Error
for i = 1 : N % Centroid of each interval
     tmp1 = quad(xf,a(i),a(i+1),0.01,[],m,sigma); %integral(x*fx)
 between[ai , ai+1]
     tmp2 = quad(f,a(i),a(i+1),0.01,[],m,sigma);%integral(fx)
 between[ai , ai+1]
     tmp = tmp1/tmp2;
     codebooks(i) = tmp; %centroids of regions
     x2f=inline(['(x-tmp).^2.*' pdf],'x','m','sigma','tmp');
     msqe = msqe + quad(x2f,a(i),a(i+1),0.01,
[],m,sigma,tmp); %Expectation of (x - Q(x))^2
end
```

Quantize

```
clc;
```

```
a = [-5,-4,-2,0,1,3,5]; %boundries of region
[index,quants,distor] = quantiz(x,a,codebooks); %quantize the signal
L = numel(x) ; %length of x
Px = sum(x.^2)/L ; %power of r.v
SQNR1 = Px /distor ; %signal to quantization noise ratio
SQNR1 = pow2db(SQNR1) ;%signal to quantization noise ratio db

fprintf(' Variance of Distortion is %f ',distor);
fprintf('\n SQNR is %f ',SQNR1);
```

```
 Variance of Distortion is 0.179592
 SQNR is -11.049212
```

Normal Distribution

```
function y=normal(x,m,s)
% FUNCTION y=NORMAL(x,m,s)
% Gaussian distribution
% m=mean
% s=standard deviation
y=(1/sqrt(2*pi*s^2))*exp(-((x-m).^2)/(2*s^2));
end
```

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