ECE 341: Probability and Random Processes for Engineers, Spring 2012
Homework 7
Name:
Assigned: 02.22.2012
Due: 02.29.2012

Problem 1. Given a uniform, continuous random variable X whose range is $[-3, 3]$. We quantize X to give Y, using L levels such that $\text{SNR}_Q(\text{dB}) = 25$. Find:

1. $E[X^2]$
2. $Var[X]$
3. μ_X
4. $E[(X - Y)^2]$
5. L
6. Verify using Matlab that your choice of L yields $\text{SNR}_Q(\text{dB}) \approx 25$

Solution 1:

Problem 2. Let W =Bernoulii(1/2) and $X = 10W - 5$ and $Y = X + N$, where N is a Gaussian random variable having zero mean. Define the SNR as $E[X^2]/E[N^2]$, or in decibels, SNR(dB)=$10\log_{10}(E[X^2]/E[N^2])$. Define the decoder output (our decision on which bit was transmitted based on the received signal Y) as a new random variable Z which is equal to 0 is $Y < 0$ and equal to 1 is $Y \geq 0$. If $Z = W$ then no error occurs, if $Z \neq W$ then an error occurred due to the additive Gaussian noise in the channel. Find:

1. The variance of N when the channel SNR is 30dB.
2. The channel SNR in dB when the variance of the RV N is 0.1.
3. The power of the noise in the channel is $E[N^2]$. Derive an expression for the probability of a bit error in the channel (probability that $Z \neq W$) in terms of the noise power.
4. Derive an expression for the probability of a bit error in the channel in terms of channel SNR.

Solution 2:

Problem 3. Let (X, Y) have the joint pmf given in the table below.

$Y = 3$	0.1	0.1	0
$Y = 2$	0	0.2	0.2
$Y = 1$	0	0.3	0.1
	$X = 1$	$X = 2$	$X = 3$

Find:

1. The pmf of X
2. The pmf of Y
3. $P[X = Y]$
4. $P[X > Y]$

Solution 3: