Homework 2

1. A constant signal can have value 0 or A=2 volts. Unfortunately, there is some white noise over the signal, with normal distribution N(0, 1). We take one sample from the overall signal, and we compare it to the threshold A/2=1 to decide what was the original value. If the sample is larger than the threshold, we decide it was 2V. If it is smaller than the threshold, we decide it was 0V.

Use the *erf(z)* function to compute the following (write the expressions with *erf(z)*, then evaluate numerically):

a). If the true signal is 0V, what is the probability that the sample value is under the threshold?
b). If the true signal is 0V, what is the probability that the sample value is over the threshold?
c). If the true signal is 2V, what is the probability that the sample value is under the threshold?
d). If the true signal is 2V, what is the probability that the sample value is over the threshold?
e). If we increase the value of A, what happens to the above probabilities? What if we decrease A?
e). If the true signal is 0V, and A has some a general value A, what is the expression for the probability that we make a mistake and wrongly decide it is A volts?
e). In the last case, find the value of A so that the probability of the mistake in this case is 1%. (find the value via multiple numerical tries)

2. We throw two fair dice and get a value V1 and a value V2 between 1 and 6.
a). Consider the sum S = V1 + V2. What is the distribution of the values of S?
b). Compute the linear convolution of the probabilities of dice 1 and dice 2 (the sequences of 6 probabilities, just like DSP class). Compare with the result of a). What is the conclusion?