Statistics and Noise 2

1. Prove the following equations:
   a. $N = \sum_{i=0}^{M-1} H_i$
   b. $\mu = \frac{1}{N} \sum_{i=0}^{M-1} iH_i$
   c. $\sigma^2 = \frac{1}{N-1} \sum_{i=0}^{M-1} (i-\mu)^2 H_i$

2. What is the difference between Pmf and Histogram? When to use Pmf and when to use Pdf?

3. Find the probability of $2\sigma < |x - \mu|$for a normal distribution and a triangle distribution.

4. Write a simple program to confirm what you found in equation 3. Assume that there is a function called *RND* that can produce a number between 0 and 1 with a uniform distribution.

5. Write a program that can produce a number in the range 3-4.5 with a uniform distribution.

6. Prove that:
   a. $\mu_{aX \pm bY} = a\mu_X \pm b\mu_Y$
   b. $\sigma^2_{aX \pm bY} = a^2\sigma_X^2 + b^2\sigma_Y^2$

7. For any probability distribution, Chebyshev's theory states that:

   $$P(\mu - k\sigma < X < \mu + k\sigma) \geq 1 - \frac{1}{k^2}$$

   a. Apply this theory to a uniform distribution for $k = 2$
   b. Apply it to a normal distribution for $k = 2$
   c. Is the result the same as what you found in problem 3 above? Why?