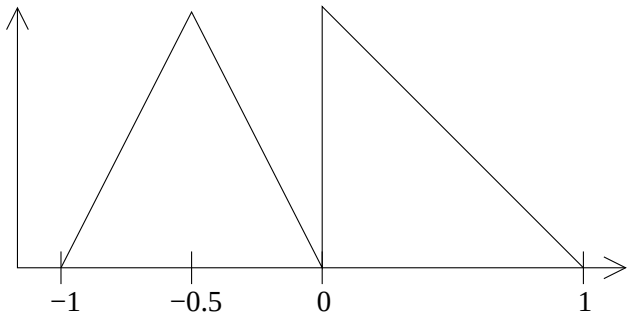
EE 521 Instrumentation and Measurements
Fall 2007
Problem for homework assignment #2

Limiting distribution

In this problem you will demonstrate that when many samples are taken from the following test distribution, $f(x)$, the sum of these samples will be distributed approximately according to a normal distribution.



1. Write the expression for the normal distribution.

2. Write down the mathematical expression for $f(x)$, including the normalization factor.

3. Write a short computer program which generates random numbers from this distribution. In doing so, note that many higher level programming languages can generate random numbers from a uniform distribution. If you choose a random number y from a uniform distribution in the range $[0; 1]$, and then compute x as

$$y = \int_{-\infty}^{x} f(x)dx$$

   then x will be distributed according to $f(x)$.

4. Demonstrate that your program works by generating a histogram of values x (say $10^4 - 10^7$ values), over-plotting $f(x)$ scaled appropriately.

5. Show that as you add 1, 2, etc random samples taken from $f(x)$, the distribution of the sum starts looking more and more like a Normal distribution. Over-plot a properly normalized normal distribution to demonstrate this.

6. For a large number of summed samples, estimate the relationship between the number of summed samples and the standard deviation, σ, of the corresponding best-fit normal distribution.