Math 261 and CS 261 Fall 2011

Assignment #7

This assignment is due at the beginning of class on ~~**Friday, November 25, 2011**~~ **Monday, November 28, 2011.**

Cubic Splines

1) Question 32, Page 164.

2) Question 33, Page 164.

3) Please follow these instructions to generate the data for your assignment.
   i) Seed the random number generator with the last 5 digits of your student number .
   ii) Generate 100 values from a uniform-(0,1) distribution, multiply them by 10, and sort these values in ascending order. Call these your *x* values. The function sort() sorts a vector i.e. `X = sort(X).`
   iii) Seed the random number generator with your complete student number.
   iv) Generate 100 values from a uniform-(0,1) distribution, multiply them by 10 and subtract 5. These unsorted values are the *y* values.

   Now that you have the data. Calculate a natural cubic spline for these values of *x* and *y*.

4) Use the same data as in Question 3) above. Let $f'(x_0)$ = 1 and $f'(x_n)$ = -2. Calculate a clamped cubic spline for these values of *x* and *y*.

Note: In addition to the coefficients of the splines, please plot the original (x,y) points and the splines on the same plot.

Monte Carlo Integration

5) For the values of *n* = 100, 1,000, 10,000, and 100,000, use Monte Carlo Integration to find the integral:

$$\int_0^2 \frac{(\sin(x) + \cos(x))^3}{4}\, dx.$$

6) If not completed during class. For the values of *n* = 100, 1,000, 10,000, and 100,000, use Monte Carlo Integration to find the integral:

$$\int_0^1 e^{-x^2} dx.$$

Simple and Scaled Random Walks

7) For the scaled random walk B of size $N = 10{,}000$. Find the area under the curve and repeat and save the results $M = 10{,}000$ times (See Algorithm 1 of the handout). Investigate the distribution of these results using a histogram. Use 25-30 bins/buckets in your histogram. Briefly comment on what you see.

8) Let $\mu = 2$ and $\sigma = 0.5$. Investigate the distribution of the integral of the transformation of the scaled random walk (Black-Scholes). Use $N = M = 10{,}000$. This corresponds with Algorithm 2 of the handout. Investigate the distribution of these results using a histogram. Use 25-30 bins/buckets in your histogram. Briefly comment on what you see.