PHYS 2411 – Fall 16

Homework 7 due: 12/02/2016

Problem 1 [50 pts]. Modified the programs provided with Lab 8 to calculate moments of a random-number distribution, $\langle r^k \rangle = \frac{1}{N}\sum_{i=1}^{N} r_i^k$, where k=1 (mean value), 2, and 3, for N=100, 1,000, 10,000 and 100,000 random real numbers over the interval [0,1]. Calculate the moments using the two random number generators in `randomSimple.hs` and `randomSystem.hs`. Compare your results with $\frac{1}{k+1}$. In addition, calculate $\sqrt{N}\left|\langle r^k \rangle - \frac{1}{k+1}\right|$ for each value of N and both random number generators. This quantities should be of order of 1 (or in the range of 0.1-10) for uncorrelated random numbers. Comment on your results and the quality of both generators. Include a copy of the piece of code with your answers.

Problem 2 [50 pts]. Write a program to determine π. Use that for a circular pond, centered at the origin and enclosed in a 2m×2m square, the area is $A_{pond} = \pi$ (r=1m). Throw N stones in random directions one after another and count how many will fall in the pond (N_{pond}). Assuming that we throw the stones uniformly and randomly, (N_{pond}/N) will be proportional to (A_{pond}/A_{sq}) and hence, $A_{pond} = \pi = (N_{pond}/N)A_{sq}$, where $A_{sq} = 4\text{m}^2$. Each of the stones will land within the square with random coordinates, x_i and y_i, where $-1\text{m} \le x_i, y_i \le 1\text{m}$. Generate the random coordinates, x_i and y_i, using the built-in [0,1] random-number generator used in `randomSystem.hs` with a change in the interval size. For N=100, 10,000, and 100,000, report the number obtained for π. How good is the result (π =3.14159265…)? Include a copy of the piece of code with your answers.