Boğaziçi University
Department of Physics

Phys 496/68N — Fall 2011

Problem Set 7

Due on December 16th, 2011

Problem 1

Consider the following integral:

$$I = \int_0^1 f(x)\,dx$$

where

$$f(x) = 3\mathrm{e}^{-10\left(x-\frac{1}{10}\right)^2} + \mathrm{e}^{-50\left(x-\frac{3}{5}\right)^2}$$

Write a Monte Carlo code that evaluates I and σ_I for $N = [10, 20, 50, 100, 200, 500, 1000, 2000, 5000]$ with $w(x) = 1$ another weight function of your choice such that your reduce the error in integration as much as possible.

N	I_1	σ_{I_1}	I_2	σ_{I_2}
10	...	...	...	...
20				

where I_1 is calculated with $w(x) = 1$, and I_2 is calculated with your weight function.

Problem 2

Consider a disk of radius $R = 1$ m with a charge density $\sigma = \alpha r$, where $\alpha = 1$ nC/m^3 is a constant, as shown in the figure.

a) Write a function that finds the potential at point P located at $x_o = 3$ m using Monte Carlo integration with a given number of samples. The prototype of the function must be `double potential(int N);`

b) Call this function 100 times with $N = 10,000,000$. Each call will return a measurement. Say these are V_i for $i = 1 \ldots 100$. Find the average potential $\bar{V} = \frac{1}{N}\sum V_i$ and its standard deviation σ_V. Then, your answer for the potential would be any of $V_i \pm \sigma_V$. Is σ_V what you expect for this problem with $N = 10,000,000$?

c) Estimate the error on the average, $\bar{V}$?