

Due Wed Nov 4th, 2015

This problem set focuses on random number generation and Monte Carlo integration.

1. Write a function that transforms a uniform deviate into a Rayleigh distributed deviate described by

$$p(y) dy = ye^{-y^2/2} dy, \quad y \geq 0.$$

Generate a suitable number of deviates and plot a normalized histogram to test your function (plot the expected Rayleigh distribution over your histogram for comparison).

2. The total mass  $M$  of an object of density  $\rho$  is given by

$$M = \int_V \rho dx dy dz,$$

where  $V$  represents the volume of the object. Using simple Monte Carlo integration, write a program that computes  $M$  and its estimated error  $\sigma_M$  if  $\rho = 1 + x^2 + 3(y + z)^2$ , where the volume of the object  $V$  is defined by  $x^2 + y^2 + z^2 \leq 9$ ,  $x \geq 0$ , and  $y \geq -1$ . Plot  $M$  with errorbars  $\sigma_M$  as a function of the number of points  $N$  used in the Monte Carlo integration, for  $N$  between 10 and  $10^7$ , in integer powers of 10.