ASSIGNMENT 6

Homeworks are due at the begining of class on the due date. The point value for the 6000 level is indicated in small font.

1 (50 (50) points) Variance Reduction in Montecarlo

In this problem, we are interested in using Monte Carlo to estimate the integral

$$I = \frac{2}{\sqrt{\pi}} \int_0^2 dx\ e^{-x^2} = \text{erf}(2)$$

For each technique, you have access to the same 1,000 uniform random variates, and based on the variance of the Monte Carlo samples, give an estimate of the error in your value.

(a) Regular Monte Carlo.

(b) Use antithetic variates.

(c) Use the control variate $C = \int_0^2 dx\ xe^{-x^2}$. In this case you need to use a few of your samples to get pilot estimates of covariances/variances.

(d) Use 1,000 points generated from the Halton sequence with base 5.

(e) Use importance sampling with 4 equal width bins.

2 (50 (50) points) Application to Option Pricing

(a) Use your simulation from the last assignment to price and get an error estimate of the average strike Asian call option.

(b) Use in addition the anti-thetic paths to price the Asian option of the previous exercise and get the error estimate.

(c) Use the European call option with strike at the current price as a control variate and give the error estimate of the resulting estimator. You will need to use the analytic formula for the European call.