PC Tutorial 1: Introduction to Bayesian Econometrics

1. Use Monte Carlo integration to find π, the ratio of circumference to diameter of a circle with radius 1. Compare it with $\pi = 3.1416$. Hint: show that the ratio of the area of the circle to the area of a surrounding square equal $\pi/4$. Based on that do the Monte Carlo integration (a graphical sketch will probably help). Also calculate the numerical standard error and determine the number of replications such that the absolute difference between π and $\hat{\pi}$ is less than 0.01 with probability of 95 percent. By repeated Monte Carlo integration check your result.

2. Suppose the posterior for a parameter, θ, is $N(0, 1)$.

   (a) Create a Matlab program which carries out Monte Carlo integration to estimate posterior mean and variance of θ.

   (b) How many replications are necessary to ensure that with a probability of 95 percent the Monte Carlo estimates of the posterior mean and variance are equal to their true values of 0 and 1 to three decimal places? Also check it by means of a Monte Carlo simulation study.

   (c) To your computer program in (b), add the code which calculates numerical standard errors for each replication $r = 1, \ldots, R$. Are these individual numerical standard errors reliable? Experiment with calculating posterior means, standard deviations, and numerical standard errors for various values of S.