## **Project II**

**Instructions:** Complete one of the following suggested probability projects.

1. Read Example E Bayesian Inference, Rice page 94 - 95.

Re-work the problem using a  $Beta(\alpha, \beta)$  prior instead of the Unif(0, 1) prior used in the example. Use

$$f_{\Theta}(\theta) = \frac{\Gamma(\alpha + \beta)}{\Gamma(\alpha)\Gamma(\beta)} \theta^{\alpha - 1} (1 - \theta)^{\beta - 1}$$
(1)

for  $0 \le \theta \le 1$ . Determine the posterior density  $f_{\Theta|X}(\theta|x)$ .

2. Read Example C Random Walk, Rice page 140 - 142.

Write an R program to simulate Brownian Motion for n = 250 values. Plot the values. Repeat 10 times. Compare your pictures to the last 250 closing values of a stock traded on the NYSE. Compare your pictures to the last 250 points of a major stock market average such as the DJIA.

3. Read Example B, rice page 154.

Simulate n = 200 values from the BVN(0, 0, 2, 3, .75). Fit the linear model with only the slope coefficient. Compare the the estimate to the  $\rho = 0.75$ .

4. Monte Carlo Integration.

Let  $U_1, U_2, ..., U_n$  be independent uniform random values from the interval [a, b]. These values have density f(u) = 1/(b-a) on that interval. Then

$$E[g(U_i)] = \int_a^b g(u) \frac{1}{b-a} \, du \tag{2}$$

so the original integral

$$\int_{a}^{b} g(x) \, dx \tag{3}$$

can be approximated by (b-a) times a sample mean of  $g(U_i)$ .

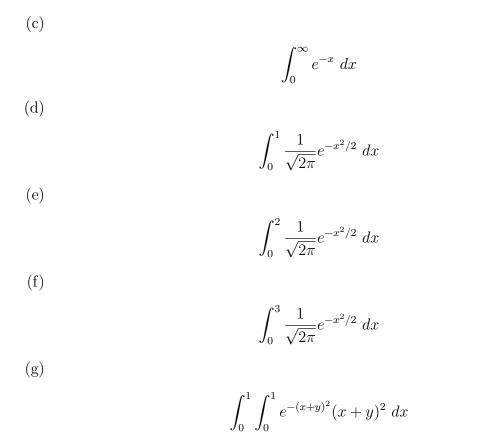
Use Monte Carlo integration to estimate the following integrals. Compare with the exact answers, if known.

(a)

$$\int_0^1 x \ dx$$

(b)

$$\int_{1}^{\pi} e^{x} dx$$



5. If you have another idea for a project, please propose it during office hours for approval.