1. Do problem 3.6 on page 97 of the textbook.

2. This problem uses stock price data in the file “Stocks Bonds FX 04-05.csv”. Specifically, two variables will be used, MSFT_AC and F_AC, which are the daily adjusted closing price of Microsoft and Ford Motor Company, respectively, for 2004–5. Today’s daily return on a stock is the relative change in its price, specifically, the difference between today’s and yesterday’s price divided by yesterday’s price. Assume that the two returns are iid and have a joint bivariate \(N(\mu, \Sigma)\) distribution for some unknown \(\mu\) and \(\Sigma\). Run the following program, which is available as “problem1_prog.R” on the course web site, to sample from the posterior distribution of the \(\Sigma\) and from the posterior distribution of the correlation between the Ford and Microsoft returns.

```r
library(MCMCpack)
data = read.csv(file='Stocks Bonds FX 04-05.csv',header = TRUE)
attach(data)
n = length(MSFT_AC)
F_R = diff(F_AC)/F_AC[1:n-1]
MSFT_R = diff(MSFT_AC)/MSFT_AC[1:n-1]
Returns = cbind(F_R,MSFT_R)
samp_cov = var(Returns)
ybar = rbind(mean(F_R),mean(MSFT_R))
mu_0 = rbind(0,0)
z = as.vector(ybar - mu_0)
lambda_0 = .001*diag(2)
lambda_0[1,2] = .0005
lambda_0[2,1] = .0005
kappa_0 = 1
kappa_n = kappa_0 + n
inv_cov = solve(samp_cov)
lambda_n_inv = lambda_0 + (n-1)*samp_cov + (kappa_0*n/kappa_n) * (z %o% z)
lambda_n = solve(lambda_n_inv)
niter = 2000
var1 = 0*(1:niter)
var2= var1
cov12 = var1
```

\(^1\text{This is little between day correlation in stock returns, so the iid assumption is reasonable though a more careful analysis might allow some correlation or a non-constant variance.}\)
corr = var1
for (i in 1:niter)
{
    sig = rwish(kappa_n, lambda_n)
    siginv = solve(sig)
    var1[i] = siginv[1,1]
    var2[i] = siginv[2,2]
    cov12[i] = siginv[1,2]
    corr[i] = cov12[i] / sqrt(var1[i] * var2[i])
}

(a) Plot a kernel density estimate of the posterior density of the correlation coefficient. You can use the R command “density” to plot the density estimate. Type “?density” for help.

(b) Find a 95% credible interval for the correlation coefficient.

(c) Suppose \(\sigma_F\), \(\sigma_M\), and \(\sigma_{F,M}\) are the standard deviation of Ford returns, the standard deviation of Microsoft returns, and the covariance between these two returns, respectively. Consider a portfolio consisting of both stocks. The return, \(R_P\), on this portfolio is given by \(R_P = wR_F + (1 - w)R_M\) where \(w\) is the proportion of the portfolio in Ford, and \(R_F\) and \(R_M\) are the returns on Ford and Microsoft.
   i. Find the value of \(w\) which, for given values of \(\sigma_F\), \(\sigma_M\), and \(\sigma_{F,M}\), minimizes the variance of \(R_P\).
   ii. Modify the R program so that you compute the posterior distribution of \(w\). Plot the posterior density of \(w\) and give a 90% credible interval for \(w\).

(d) What prior distribution is used by this program?