

## ORIE 678 — D. Ruppert

### R2WinBUGS example: linear regression with normal errors

The following R and BUGS programs demonstrate a Bayesian analysis of a linear regression model with normally distributed errors.

R program in the file “linear\_regression\_normal.R”:

```
library(R2WinBUGS)
N = 50
beta1 = 1
beta2 = 3
beta0 = 1
x1 = rnorm(N,mean=3,sd=2)
x2 = x1/4 + rnorm(N,mean=3,sd=2)
x=cbind(rep(1,N),x1,x2)

y = beta0 + beta1*x1 + beta2*x2 + rnorm(N,mean=0,sd=.2)
data=list("y","x","N")
inits=function(){list(beta=rep(0,3),tau=.3)}

univnorm.sim = bugs(data,inits,model.file="lin_reg.bug",
parameters=c("beta","tau"),n.chains = 1,n.iter=5100,n.burnin=100,n.thin=1,
bugs.directory="c:/Program Files/WinBUGS14/",codaPkg=FALSE)

beta1 = univnorm.sim$sims.array[,1,1]
beta2 = univnorm.sim$sims.array[,1,2]
beta3 = univnorm.sim$sims.array[,1,3]
tau = univnorm.sim$sims.array[,1,4]
sigma = 1/sqrt(tau)

pdf('lin_reg_trace.pdf')
par(mfrow=c(2,2))
ts.plot(beta1,xlab="iteration",ylab="",main="beta1")
ts.plot(beta2,xlab="iteration",ylab="",main="beta2")
ts.plot(beta3,xlab="iteration",ylab="",main="beta3")
ts.plot(sigma,xlab="iteration",ylab="",main="sigma")

pdf('lin_reg_kde.pdf')
par(mfrow=c(2,2))
plot(density(beta1),main="beta1")
plot(density(beta2),main="beta2")
plot(density(beta3),main="beta3")
plot(density(sigma),main="sigma")

pdf('lin_reg_acf.pdf')
par(mfrow=c(2,2))
acf(beta1,main="beta1")
acf(beta2,main="beta2")
```

```
acf(beta3,main="beta3")
acf(sigma,main="sigma")
```

```
graphics.off()
```

BUGS program in the file “linear\_regression\_normal.bug”:

```
model{
for(i in 1:N){
y[i] ~ dnorm(mu[i],tau)
mu[i] <- x[i,1]*beta[1] + x[i,2]*beta[2] + x[i,3]*beta[3]
}

for(i in 1:3){beta[i] ~ dnorm(0,.00001)}
tau ~ dgamma(0.01,0.01)
}
```

The plots are on the next three pages.

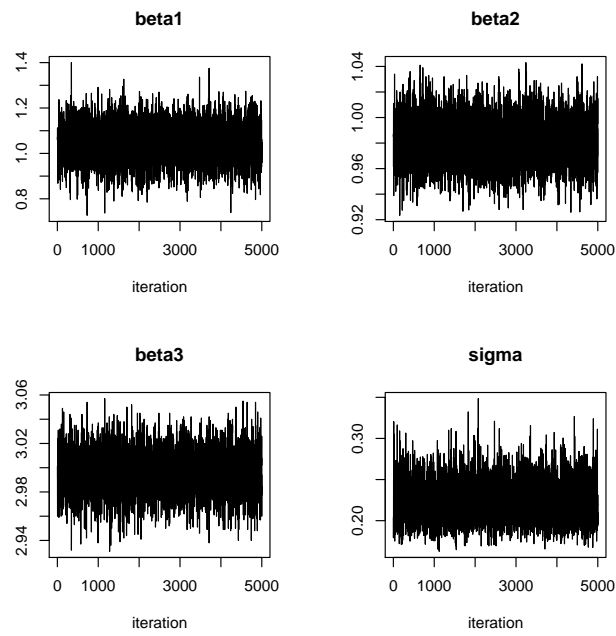


Figure 1: Trace plots.

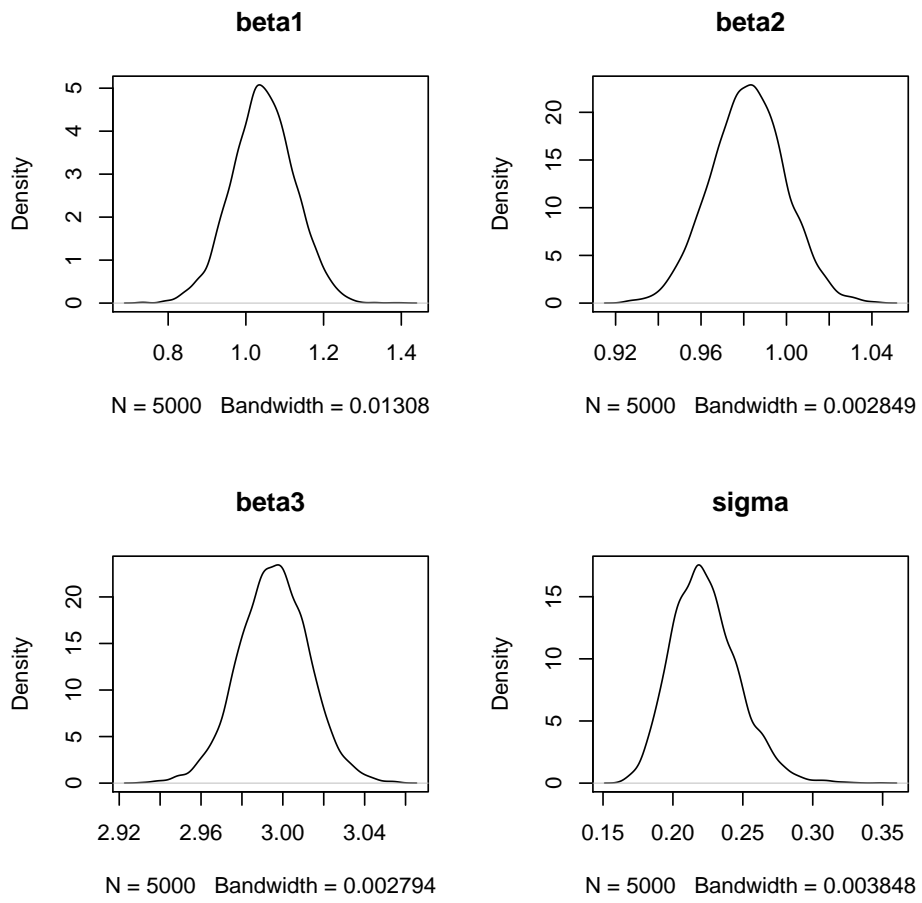


Figure 2: Kernel density estimates of the marginal posterior densities.

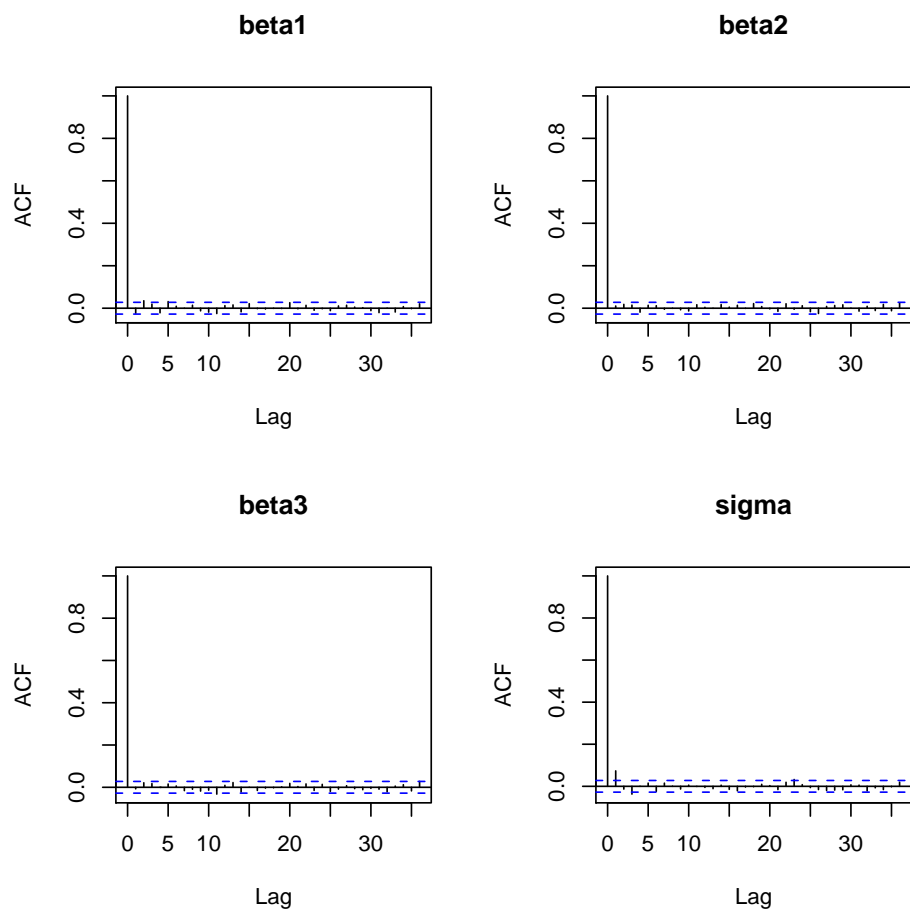


Figure 3: Plots of the ACFs.