Convergence diagnostics for a ill-posed model

Chapter 3.4: Diagnosing and improving convergence

In this example the chains **do not converge** and we show how the convergence diagnostics flag non-convergence. The model is contrived to give poor convergence. It is \[Y\sim\mbox{Poisson}(\exp[\mu_1+\mu_2]) \mbox{ where }\mu_1,\mu_2\sim\mbox{Normal}(0,1000).\] This is a silly model because there is only one observation, \(Y=1\), and two parameters. Further, the two parameter give the same likelihood for all combinations of \(\mu_1\) and \(\mu_2\) that give the same sum.

Define the model as a string

```
model_string <- textConnection("model{
  Y      ~ dpois(exp(mu[1]+mu[2]))
  mu[1] ~ dnorm(0,0.001)
  mu[2] ~ dnorm(0,0.001)
}")
```

Generate posterior samples

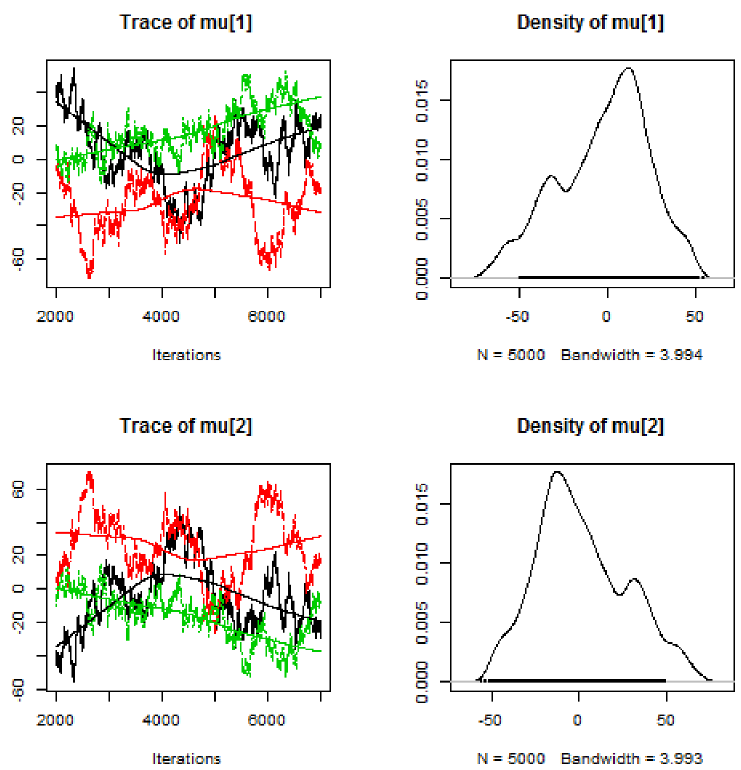
```
inits <- list(mu=rnorm(2,0,5))
data  <- list(Y=1)
model <- jags.model(model_string,data = data, inits=inits, n.chains=3, quiet=TRUE)

update(model, 1000, progress.bar="none")
samples <- coda.samples(model,
           variable.names=c("mu"),
           n.iter=5000, progress.bar="none")
```

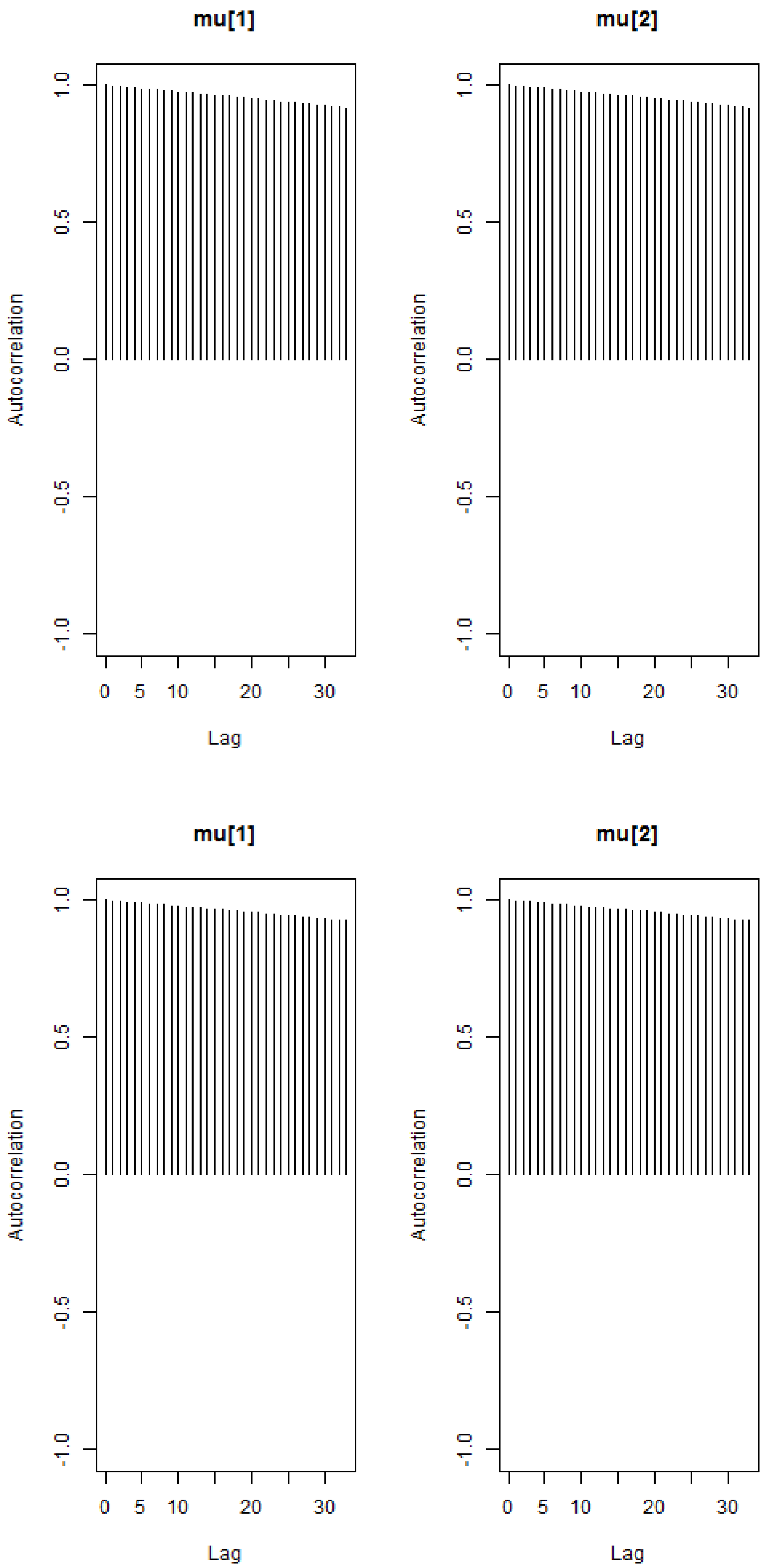
Graphical diagnostics

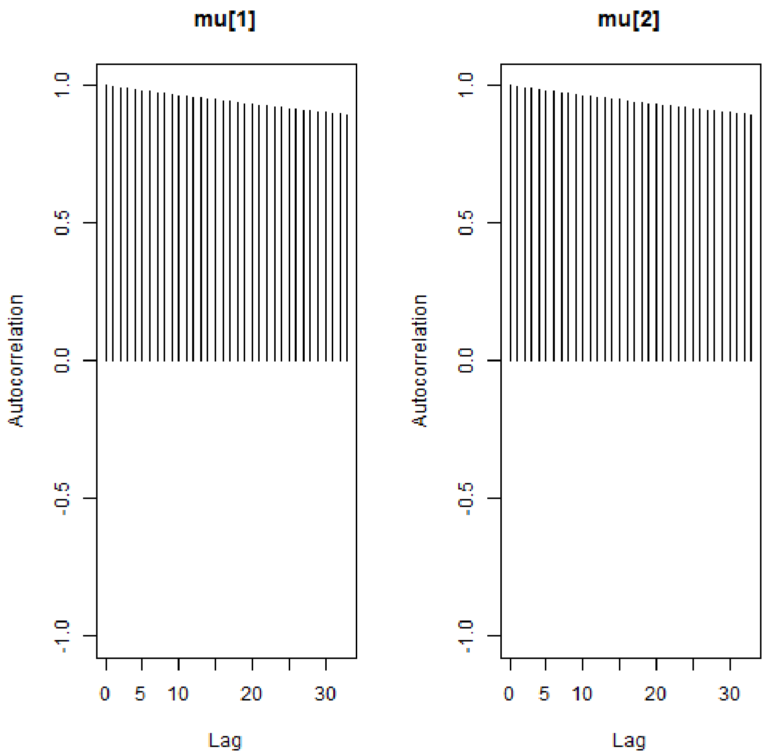
The trace plots are meandering, the chains (each chain is a different color) give different estimates, and the autocorrelation is high even for lag 35. All of these indicate poor convergence.

```
plot(samples)
```




```
autocorr.plot(samples)
```


mu[1]
mu[2]
Autocorrelation
1.0
0.5
0.0
-0.5
-1.0
0
5
10
20
30
Lag
mu[1]
mu[2]
Autocorrelation
Lag



Numerical diagnostics

```
# Autocorrelation near 1 indicates poor convergence
autocorr(samples[[1]],lag=1)
```

```
## , , mu[1]
##
##            mu[1]      mu[2]
## Lag 1 0.9969476 -0.9957215
##
## , , mu[2]
##
##             mu[1]     mu[2]
## Lag 1 -0.9975801 0.9970195
```

```
# Low ESS indicates poor convergence
effectiveSize(samples)
```

```
##    mu[1]    mu[2]
## 21.18113 20.71919
```

```
# R greater than 1.1 indicates poor convergence
gelman.diag(samples)
```

```
## Potential scale reduction factors:
##
##       Point est. Upper C.I.
## mu[1]       2.01        3.5
## mu[2]       2.01        3.5
##
## Multivariate psrf
##
## 1.8
```

```
# |z| greater than 2 indicates poor convergence
geweke.diag(samples[[1]])
```

```
##
## Fraction in 1st window = 0.1
## Fraction in 2nd window = 0.5
##
##  mu[1]  mu[2]
##  3.239 -3.347
```