STAT 578 - Advanced Bayesian Modeling - Fall 2019
Assignment 3

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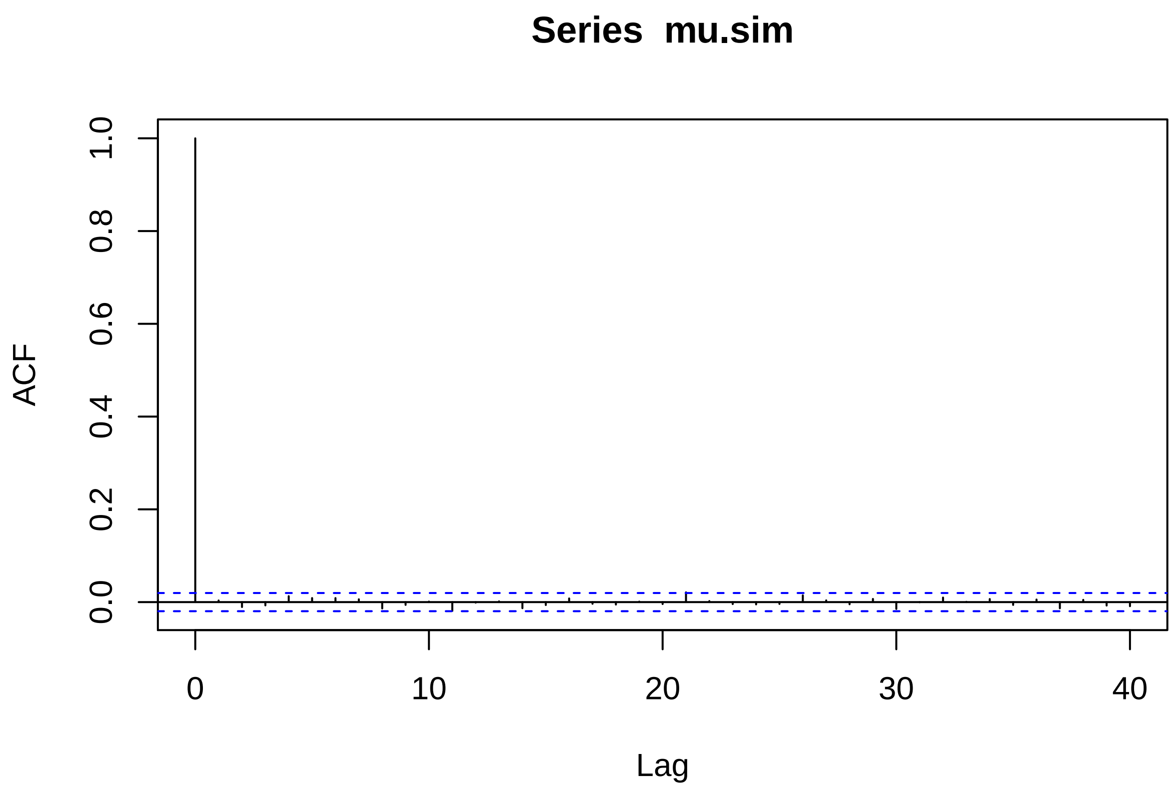
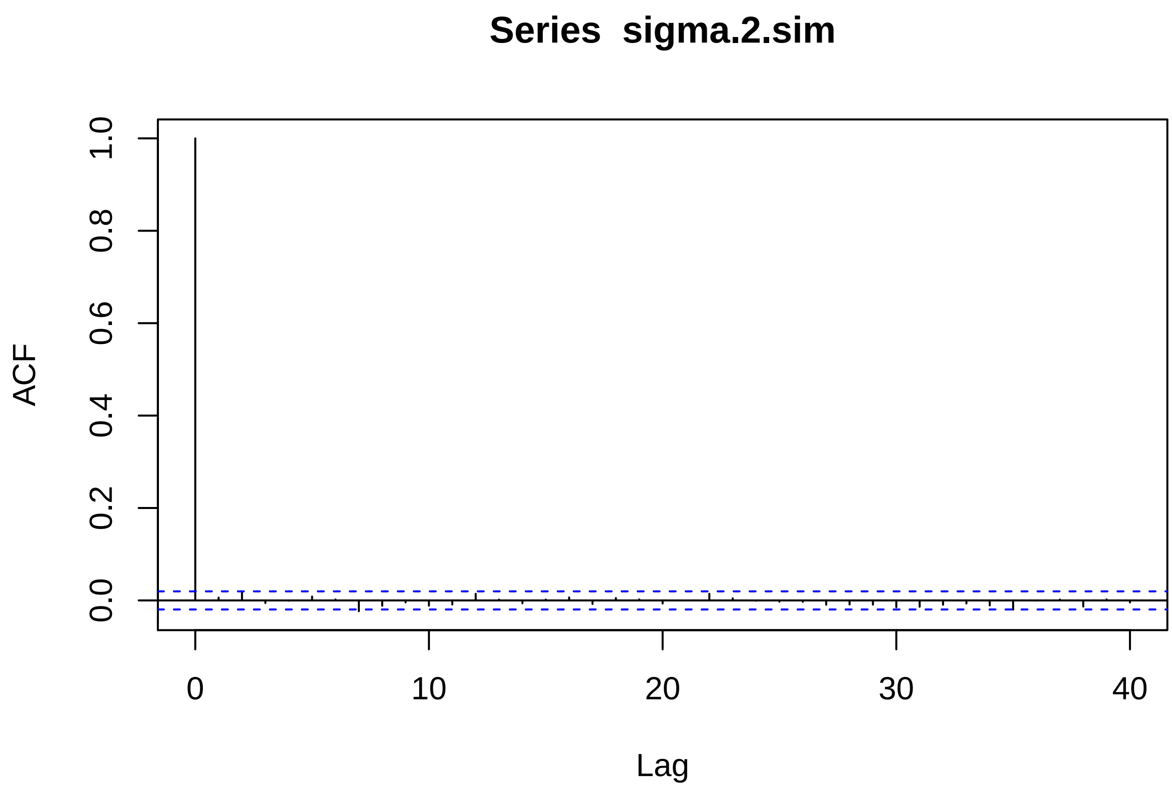
Solution for Problem 1

(a)

```
source("FlintGibbs.R")
acf(mu.sim)
```




```
acf(sigma.2.sim)
```



(b)

(i)

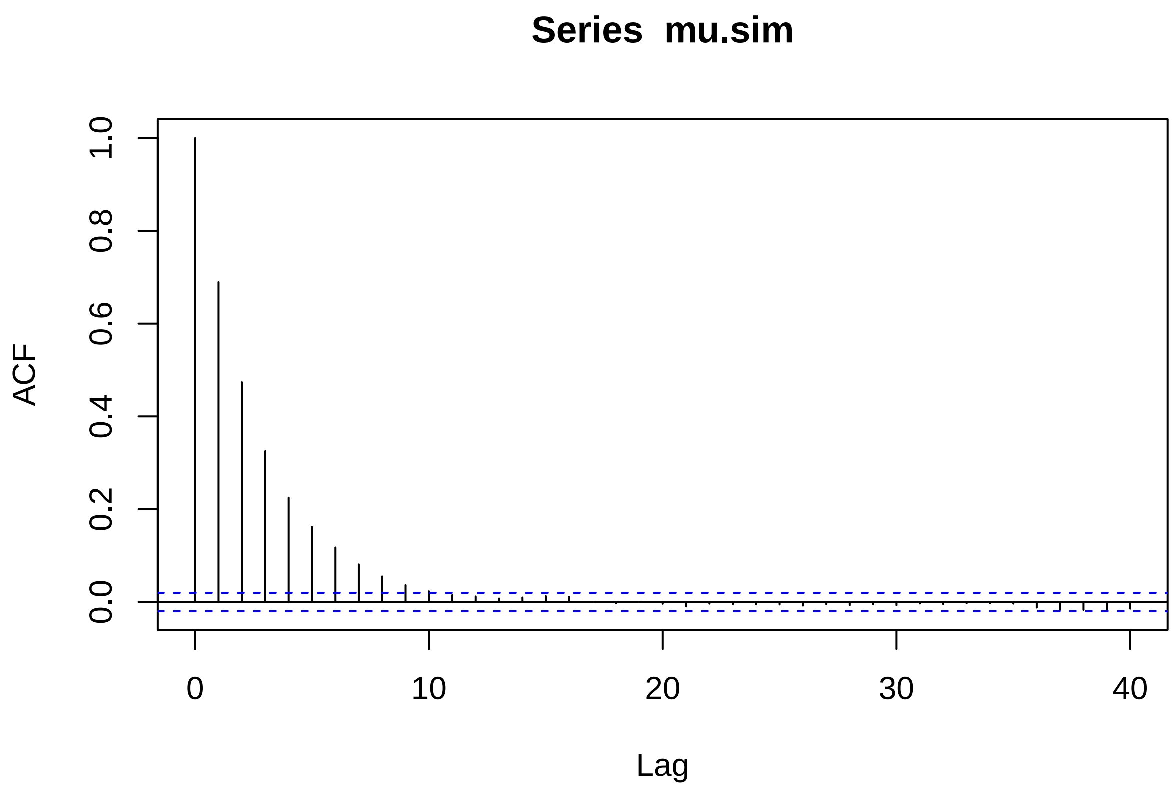
```r
rho <- 0.03
source("FlintMetropolis.R")
```

```
## [1] 0.3522545
```

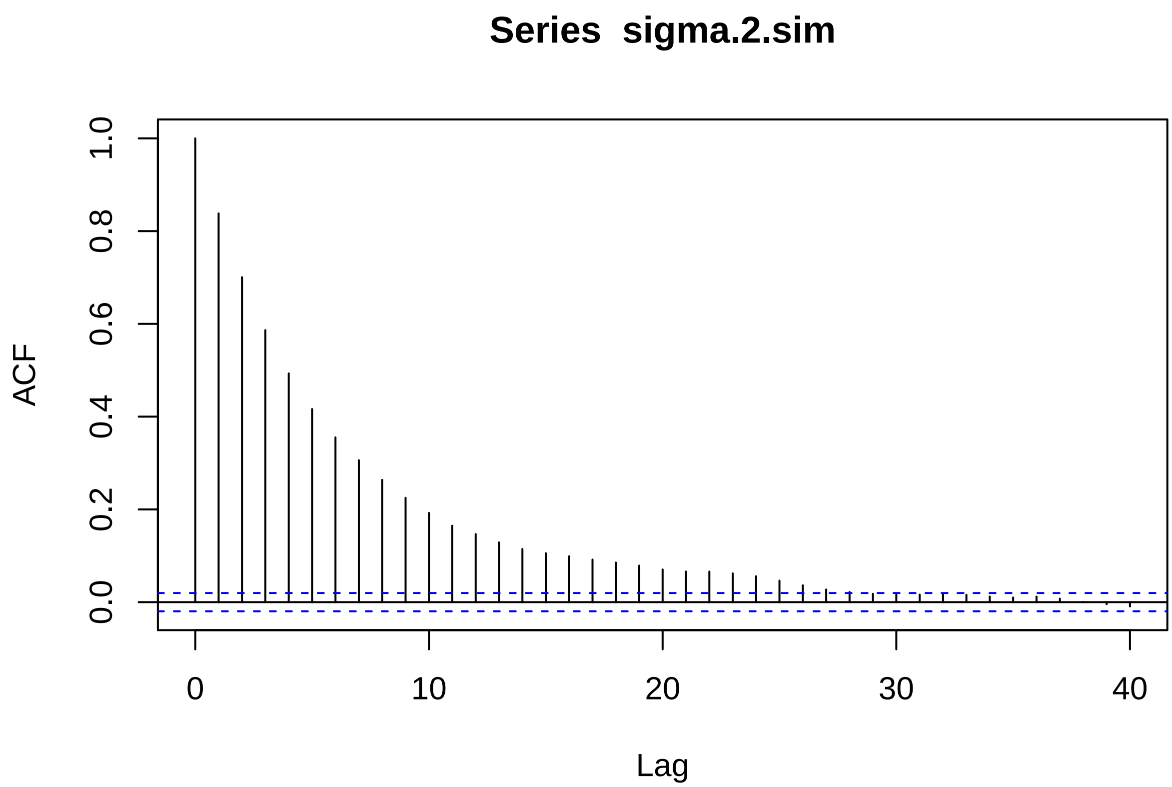
ρ takes 0.03 will give acceptance rate of about 0.35.

(ii)

```r
acf(mu.sim)
```




```
acf(sigma.2.sim)
```



(c)

The autocorrelation plot for Gibbs sampler decays much faster than Metropolis sampler's. Thus, Gibbs sampler exhibited faster mixing.

Solution for Problem 1

(a)

```r
library(rjags)
```

```
## Loading required package: coda
```

```
## Linked to JAGS 4.3.0
```

```
## Loaded modules: basemod,bugs
```

```r
polls2016_df <- read.table("polls2016.txt", header=TRUE)
polls2016_df$sigma <- polls2016_df$ME/2
polls2016_df <- subset(polls2016_df, select = -c(poll, ME) )
```

(i)

```r
initial_vals <- list(list(mu = 100, tau = 100),
                     list(mu = 100, tau = 0.01),
```

```
                      list(mu = -100, tau = 100),
                      list(mu = -100, tau = 0.01))

poll_model <- jags.model("polls20161.bug", polls2016_df, initial_vals, n.chains = 4)
```

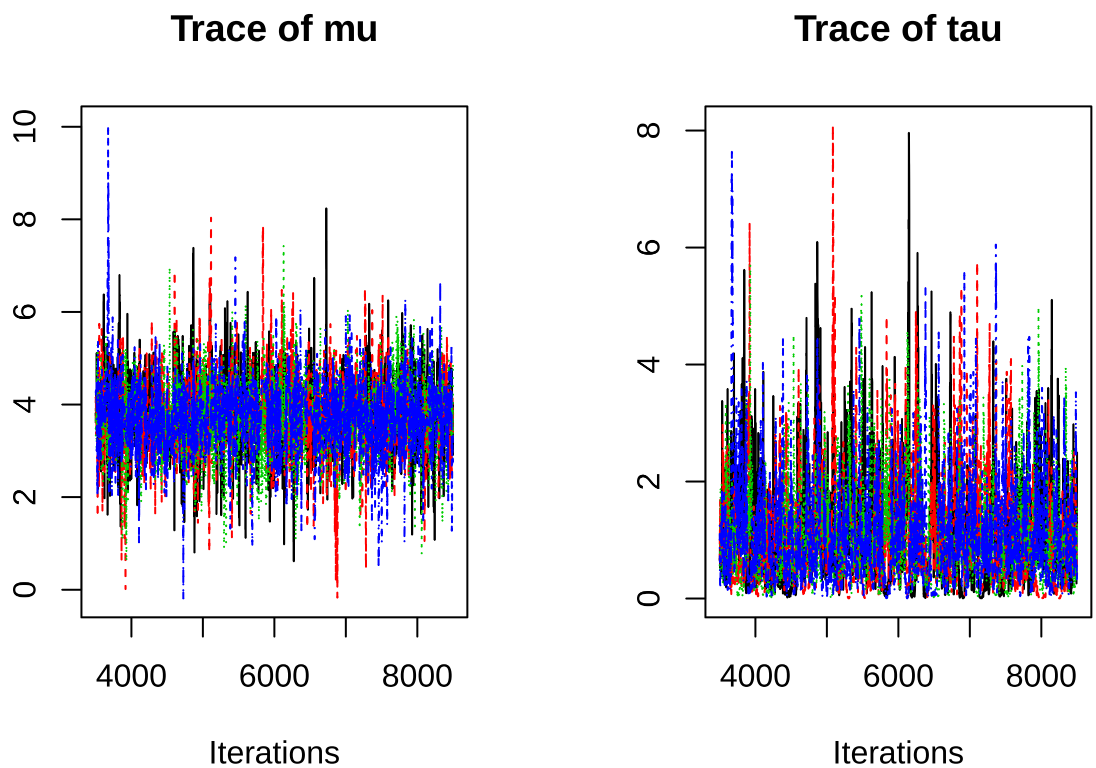
```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 7
##    Unobserved stochastic nodes: 9
##    Total graph size: 42
##
## Initializing model
```

(ii)

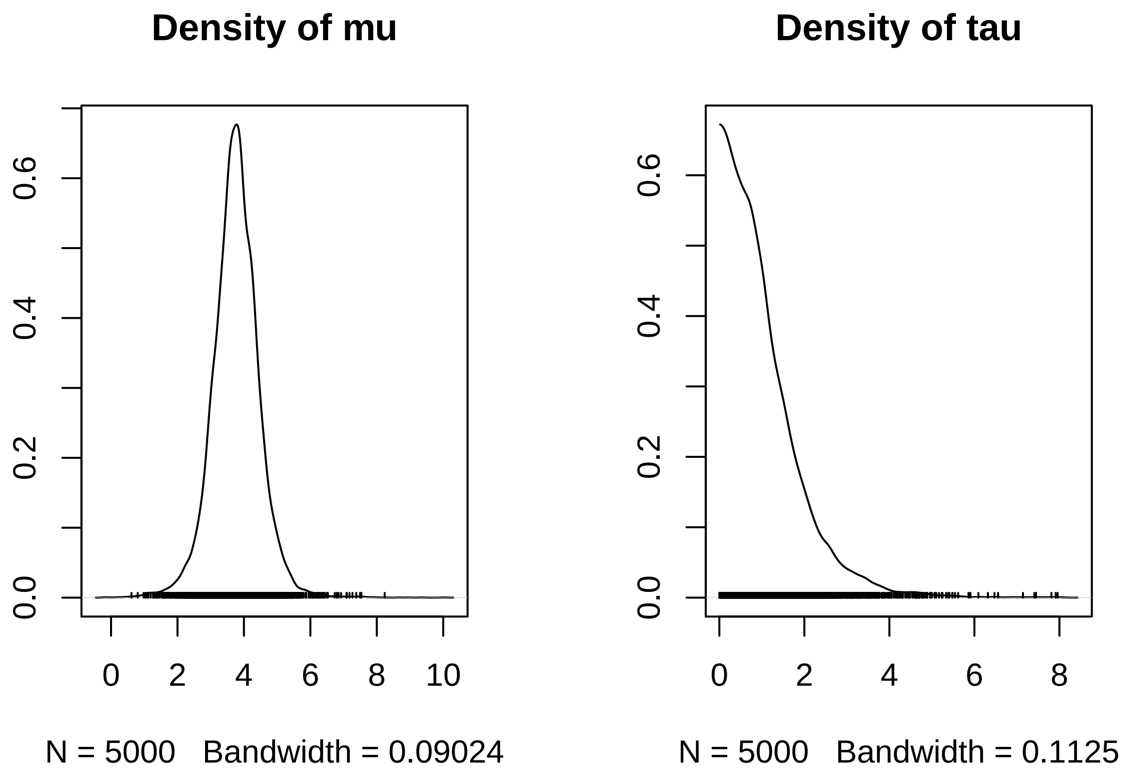
```
update(poll_model, 2500)
x <- coda.samples(poll_model, c("mu","tau"), n.iter = 5000)
```

(iii)

```
plot(x, smooth=FALSE, density = FALSE)
```




```
plot(x, smooth=FALSE, trace = FALSE)
```



The trace plot shows 4 chains for mu and tau span the similar range and we can't observe obvious convergence problem.

(iv)

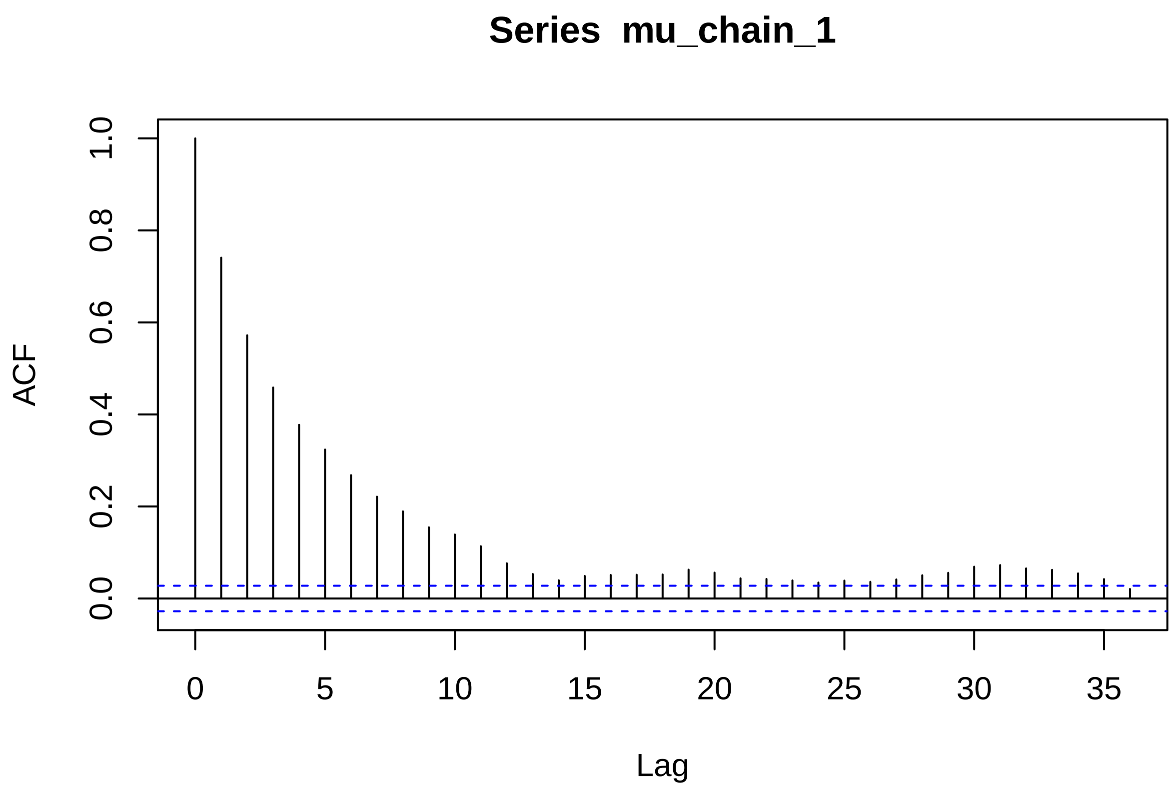
```
gelman.diag(x, autoburnin=FALSE)
```

```
## Potential scale reduction factors:
##
##     Point est. Upper C.I.
## mu        1.00       1.00
## tau       1.01       1.02
##
## Multivariate psrf
##
## 1
```

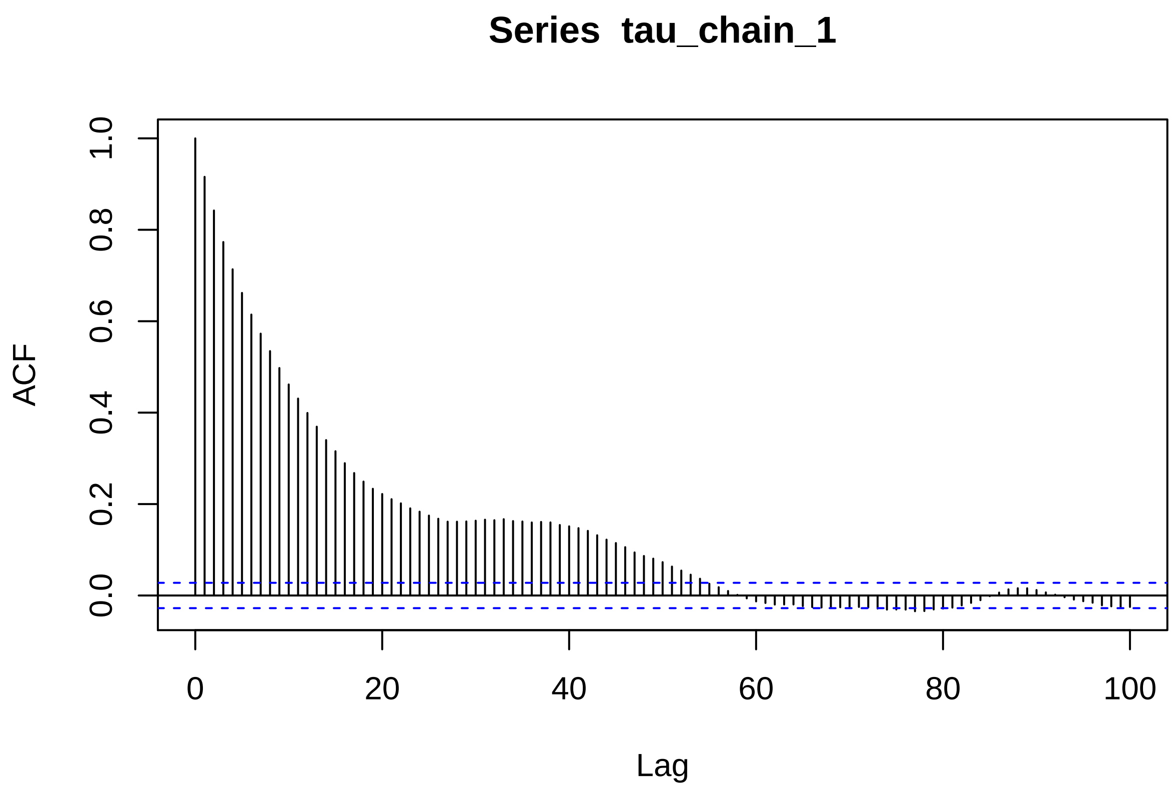
Gelman-Rubin statistics (Potential scale reduction factor) for mu and tau are close to 1 with upper confidence limits close to 1, thus there don't appear to have any convergence problem.

(v)

```
mu_chain_1  = x[[1]][,1]
tau_chain_1 = x[[1]][,2]
acf(mu_chain_1)
```




```r
acf(tau_chain_1, lag.max = 100)
```



We see autocorrelation (of Chain 1) goes zero for mu by lag around 15 and for tau by lag around 80. Thus mixing of mu is faster than tau's.

(vi)

```
effectiveSize(x)
```

```
##        mu       tau
## 2319.6440  928.5312
```

The effective sample size for mu and tau is less than 2000, thus our sample size of 5000 is adequate.

(b)

(i)

```
model {
  for (j in 1:length(y)) {
    y[j] ~ dnorm(theta[j], 1/sigma[j]^2)
    theta[j] ~ dnorm(mu, 1/tau^2)
  }

  mu ~ dunif(-1000,1000)
  logtau ~ dunif(-100, 100)
  tau <- exp(logtau)
}
```

(ii)

```r
initial_vals_new <- list(list(mu = 100, logtau = 100),
                     list(mu = 100, logtau = 0.01),
                     list(mu = -100, logtau = 100),
                     list(mu = -100, logtau = 0.01))

poll_model_new <- jags.model("polls20161_new.bug", polls2016_df, initial_vals_new, n.chains = 4)
```

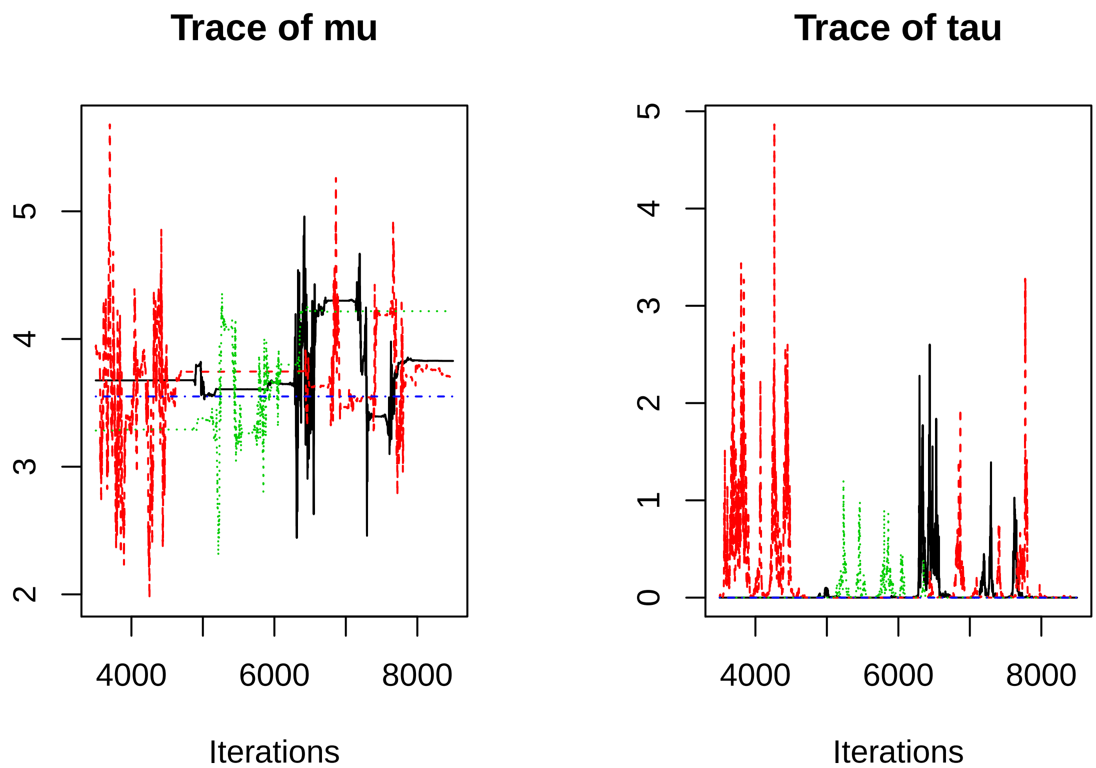
```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 7
##    Unobserved stochastic nodes: 9
##    Total graph size: 44
##
## Initializing model
```

(iii)

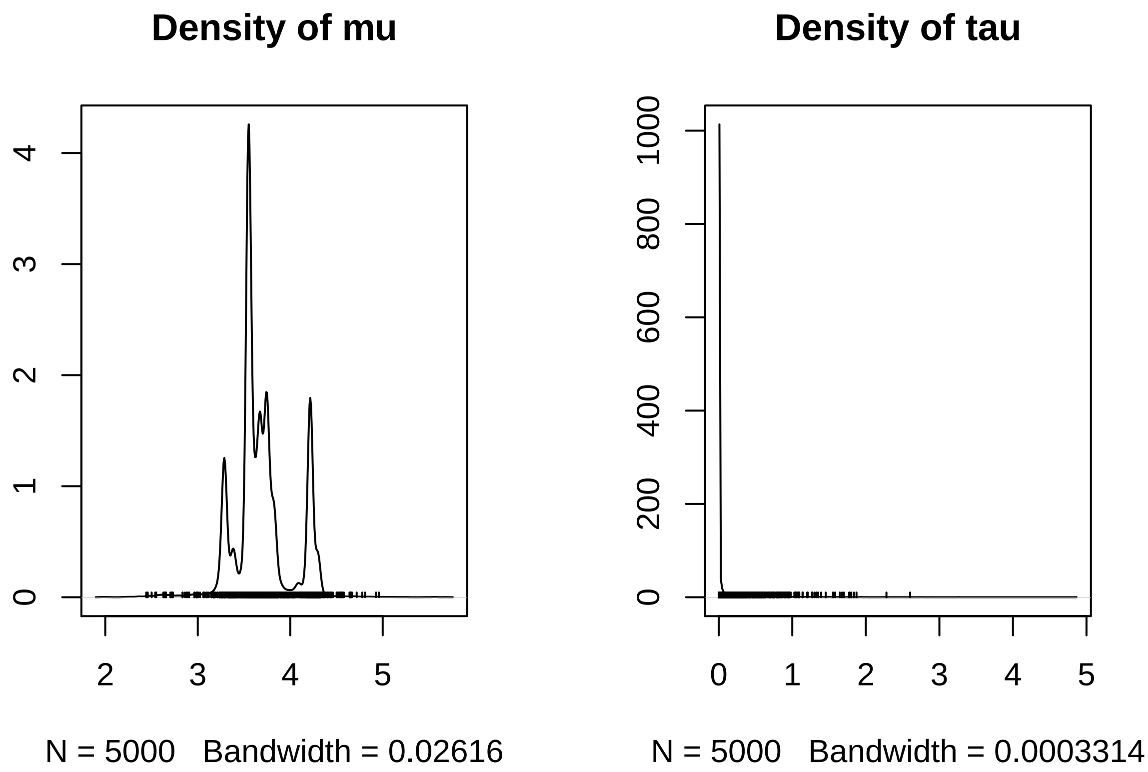
```r
update(poll_model_new, 2500)
x_new <- coda.samples(poll_model_new, c("mu","tau"), n.iter = 5000)
```

(iv)

```r
plot(x_new, smooth=FALSE, density = FALSE)
```




```
plot(x_new, smooth=FALSE, trace = FALSE)
```



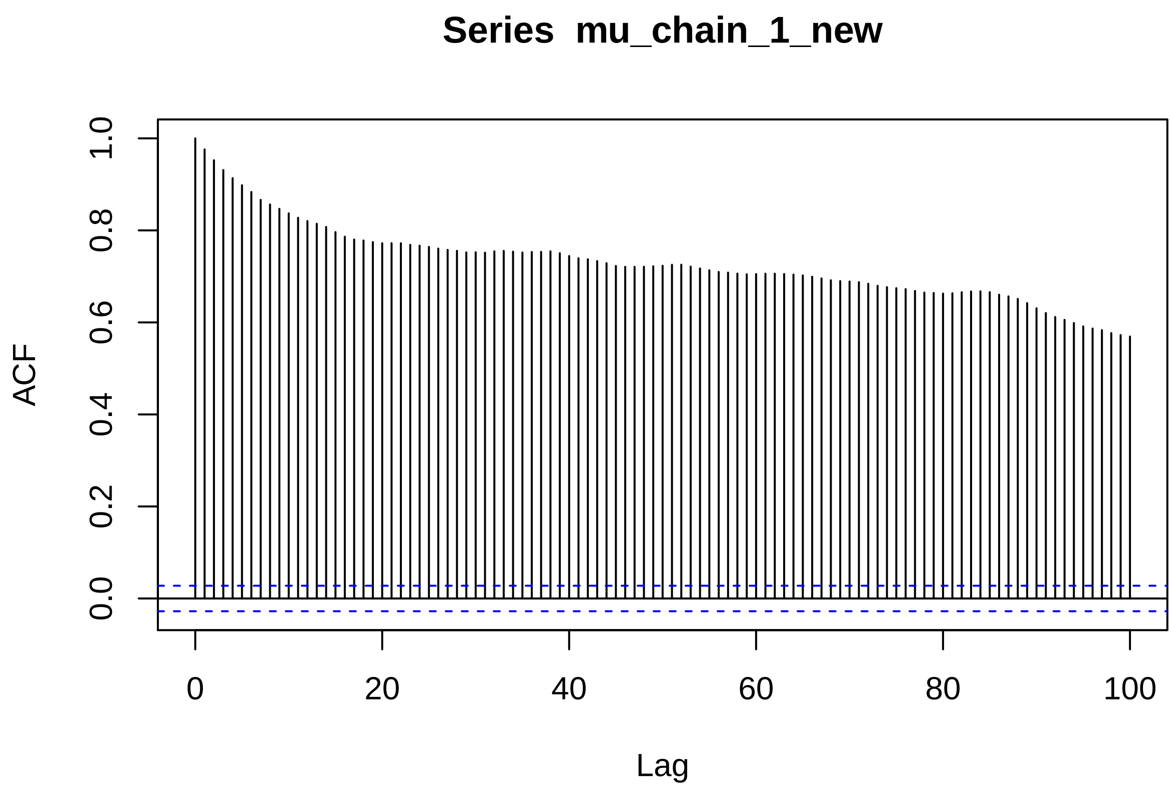
(v)

```r
gelman.diag(x_new, autoburnin=FALSE)
```

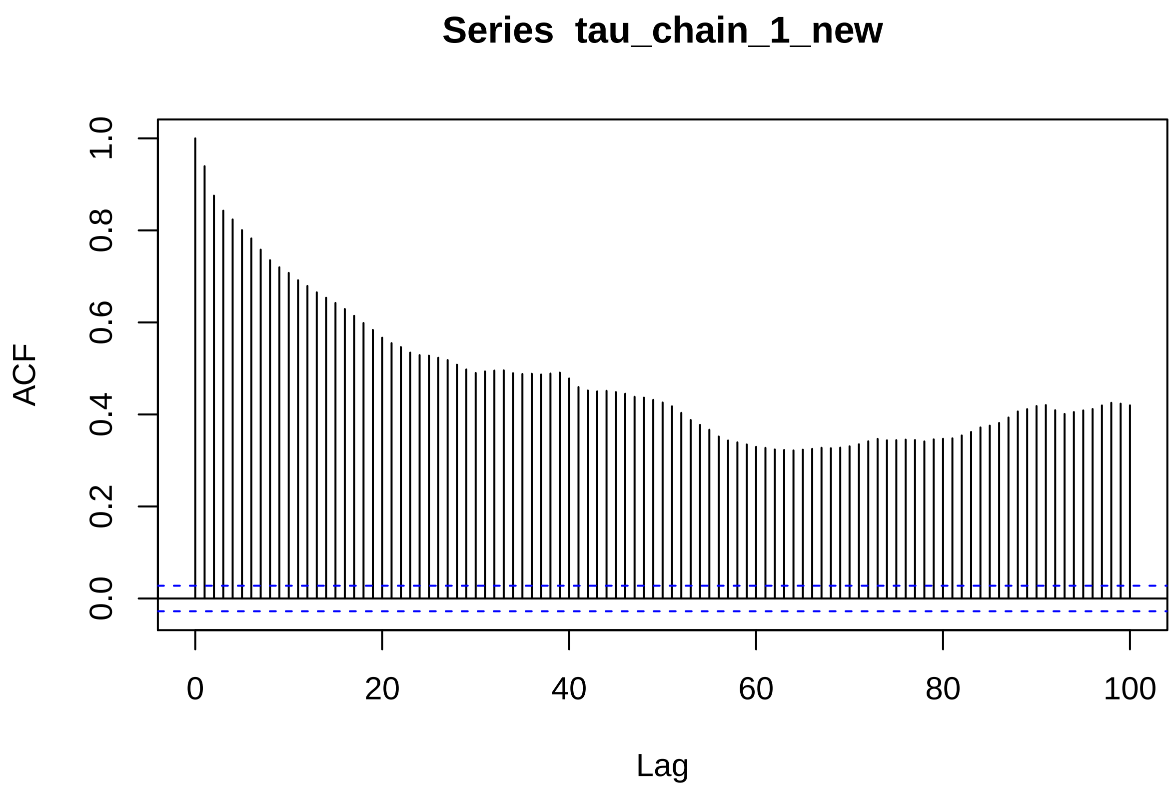
```
## Potential scale reduction factors:
##
##     Point est. Upper C.I.
## mu        1.13       1.36
## tau       1.24       1.70
##
## Multivariate psrf
##
## 1.1
```

(vi)

```r
mu_chain_1_new  = x_new[[1]][,1]
tau_chain_1_new = x_new[[1]][,2]
acf(mu_chain_1_new, lag.max = 100)
```




```r
acf(tau_chain_1_new, lag.max = 100)
```



(vii)