Gibbs_example_coal

load data

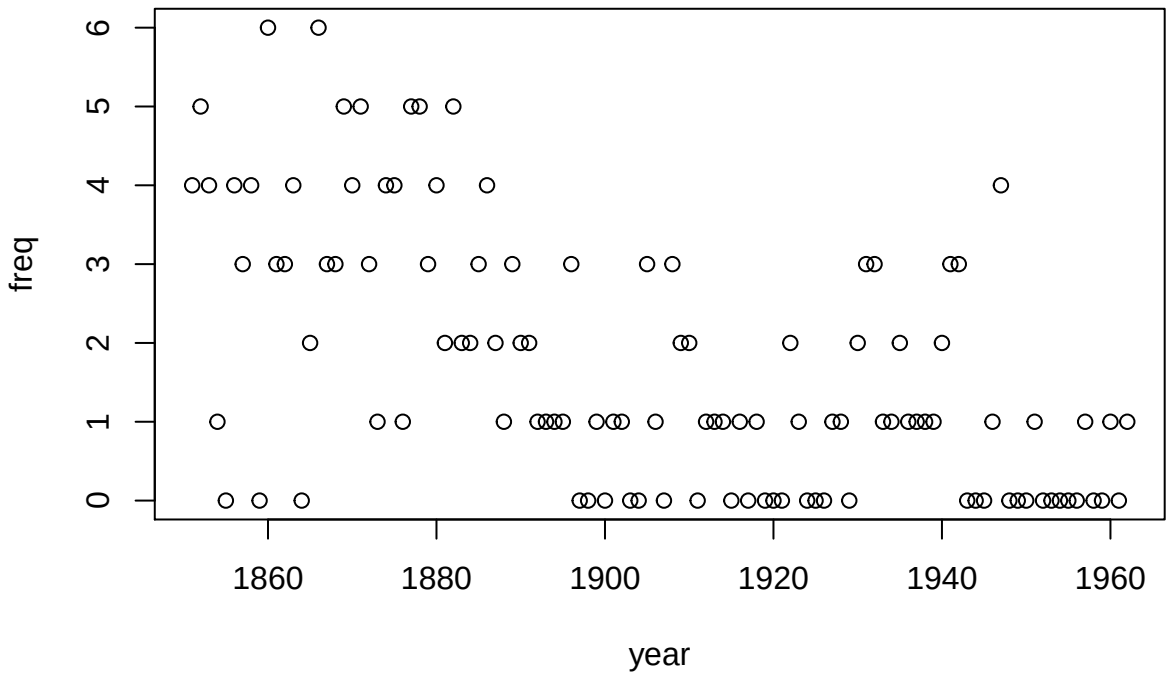
```
library(boot)
data(coal)
str(coal)
```

```
## 'data.frame':    191 obs. of  1 variable:
##  $ date: num  1851 1852 1852 1852 1852 ...
```

```
when <- floor(coal)
year <- 1851:1962
freq <- sapply(year, function(x, y) sum(y==x), y=when)
str(freq)
```

```
##  int [1:112] 4 5 4 1 0 4 3 4 0 6 ...
```

```
n <- length(freq)
plot(year, freq)
```



Implement Gibbs Sampler

```
GibbsS <- function(la1, la2, M, nreps, freq){

  # priors; uniform for M
```

```
  a1 <- .5
  b1 <- .001
  a2 <- .5
  b2 <- .001

  Gsamples <- matrix(nrow=nreps, ncol=3)
  Gsamples[1,] <- c(la1, la2, M)

  # main loop
  cfreq <- cumsum(freq)
  for (i in 2:nreps) {
    la1 <- rgamma(1, a1 + cfreq[M], b1 + M)
    la2 <- rgamma(1, a2 + cfreq[n] - cfreq[M], b2 + n - M)
    M <- sample(1:n, 1, prob=(la1/la2)^cfreq*exp((la2-la1)*(1:n)))
    Gsamples[i,] <- c(la1, la2, M)
  }

  return(Gsamples=Gsamples)
}
```

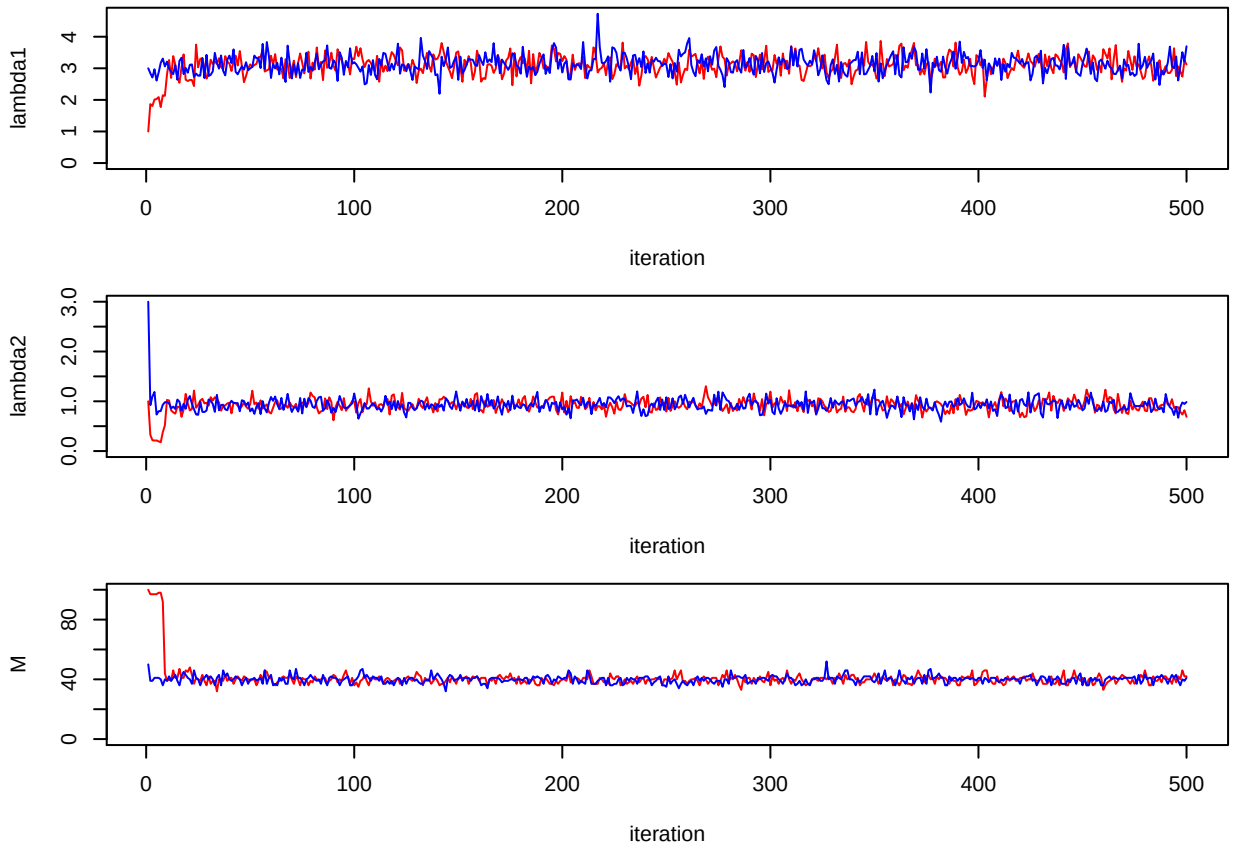
Simulate two Markov Chains (of length 500) using Gibbs Sampler

```
# sample size
nreps <- 500

# initial values
la1 <- 1
la2 <- 1
M <- 100

GibbsS1 = GibbsS(la1, la2, M, nreps, freq)

# initial values
la1 <- 3
la2 <- 3
M <- 50

GibbsS2 = GibbsS(la1, la2, M, nreps, freq)
```

trace plot

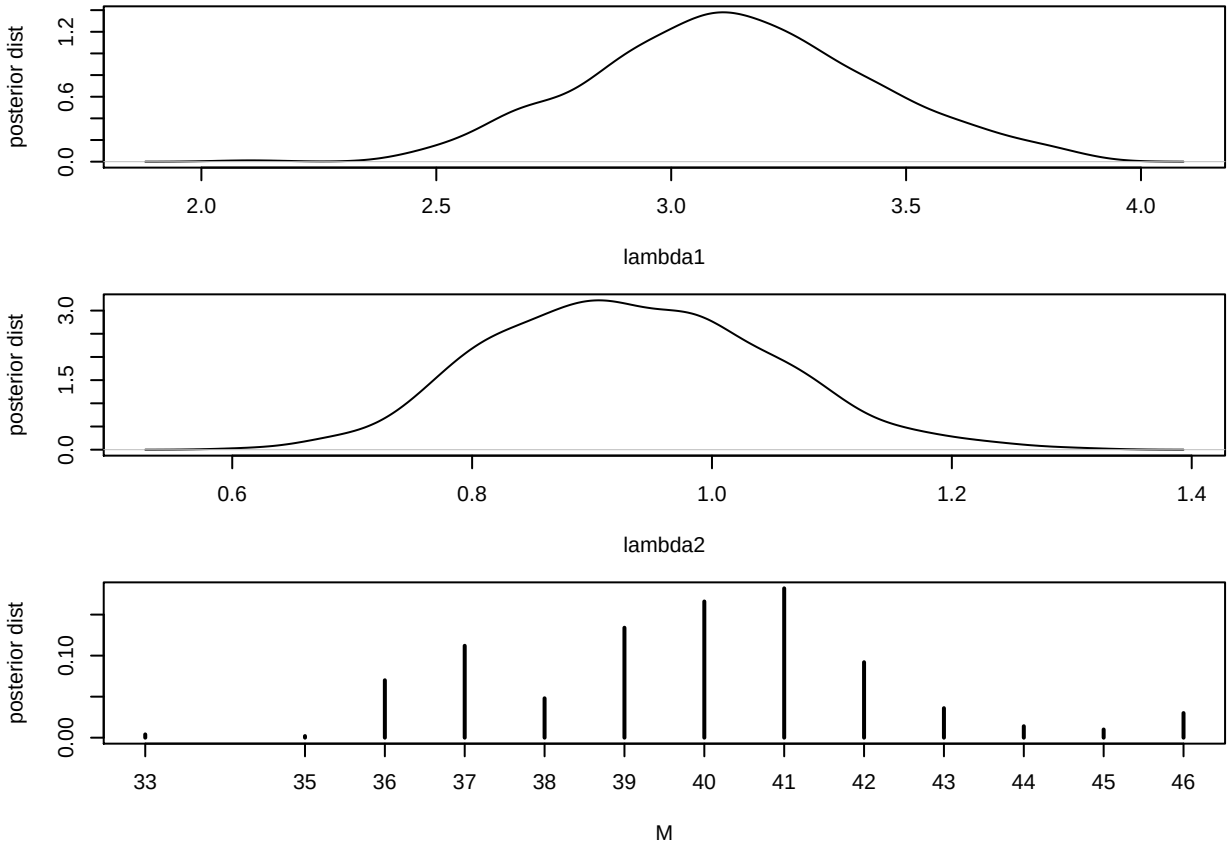
```
par(mfrow=c(3,1), mar=c(4,4,1,1))
plot(1:nreps, GibbsS1[,1], type="l", col="red", ylim = c(0, max(GibbsS1[,1],GibbsS2[,1])),
     xlab = "iteration", ylab ="lambda1")
points(1:nreps, GibbsS2[,1], type="l", col="blue")

plot(1:nreps, GibbsS1[,2], type="l", col="red", ylim = c(0, max(GibbsS1[,2],GibbsS2[,2])),
     xlab = "iteration", ylab ="lambda2")
points(1:nreps, GibbsS2[,2], type="l", col="blue")

plot(1:nreps, GibbsS1[,3], type="l", col="red", ylim = c(0, max(GibbsS1[,3],GibbsS2[,3])),
```

```
     xlab = "iteration", ylab ="M")
points(1:nreps, GibbsS2[,3], type="l", col="blue")
```



Posterior distribution after discarding the first 50 samples as a burn-in.

```
par(mfrow=c(3,1), mar=c(4,4,1,1))
plot(density(GibbsS1[-(1:50),1]), ylab="posterior dist", xlab="lambda1", main="")
plot(density(GibbsS1[-(1:50),2]), ylab="posterior dist", xlab="lambda2", main="")
plot(table(GibbsS1[-(1:50),3])/nreps, ylab="posterior dist", xlab="M", main="")
```


posterior dist
0.0
0.6
1.2
2.0
2.5
3.0
3.5
4.0
lambda1
posterior dist
0.0
1.5
3.0
0.6
0.8
1.0
1.2
1.4
lambda2
posterior dist
0.00
0.10
33
35
36
37
38
39
40
41
42
43
44
45
46
M