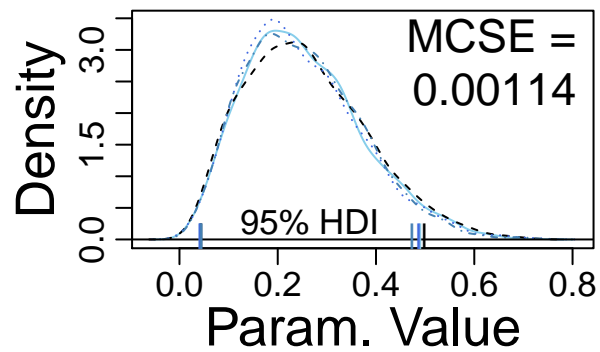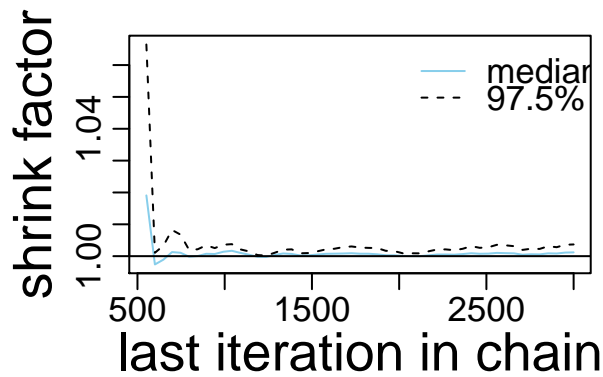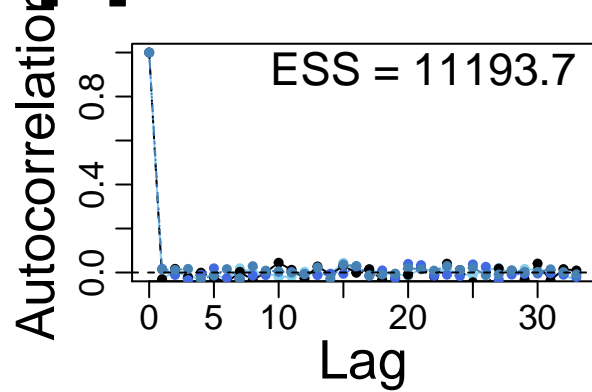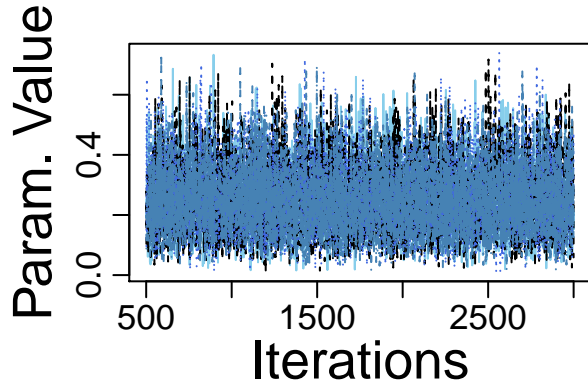# MA677 Assignment JAGS

Yiping Jiang

4/13/2020

Exercise 8.1

```
## Loading required package: rjags

## Loading required package: coda

## Linked to JAGS 4.3.0

## Loaded modules: basemod,bugs

##
## ********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## ********************************************************************

## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 20
##    Unobserved stochastic nodes: 3
##    Total graph size: 46
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

theta[1]


```
##                        Mean      Median        Mode      ESS HDImass
## theta[1]         0.25315187  0.23952342  0.18905822 10000.0    0.95
## theta[2]         0.55696581  0.56194355  0.59256203 10000.0    0.95
## theta[3]         0.54449123  0.54800260  0.56119375  9861.8    0.95
## theta[1]-theta[2] -0.30381394 -0.31304991 -0.32802751 10000.0   0.95
## theta[1]-theta[3] -0.29133936 -0.29484662 -0.28357501 10000.0   0.95
## theta[2]-theta[3]  0.01247458  0.01479967  0.02610817 10000.0   0.95
##                       HDIlow     HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]          0.04190476  0.48656064      NA            NA      NA       NA
## theta[2]          0.26037977  0.85454663      NA            NA      NA       NA
## theta[3]          0.27348257  0.82883707      NA            NA      NA       NA
## theta[1]-theta[2] -0.68208998  0.09198754       0          7.05      NA       NA
## theta[1]-theta[3] -0.65136794  0.07923732       0          6.54      NA       NA
## theta[2]-theta[3] -0.38696135  0.44108889       0         52.68      NA       NA
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                  NA         NA         NA
## theta[2]                  NA         NA         NA
## theta[3]                  NA         NA         NA
## theta[1]-theta[2]         NA         NA         NA
## theta[1]-theta[3]         NA         NA         NA
## theta[2]-theta[3]         NA         NA         NA
##
##                        Mean      Median        Mode      ESS HDImass
## theta[1]         0.25315187  0.23952342  0.18905822 10000.0    0.95
## theta[2]         0.55696581  0.56194355  0.59256203 10000.0    0.95
## theta[3]         0.54449123  0.54800260  0.56119375  9861.8    0.95
## theta[1]-theta[2] -0.30381394 -0.31304991 -0.32802751 10000.0   0.95
```
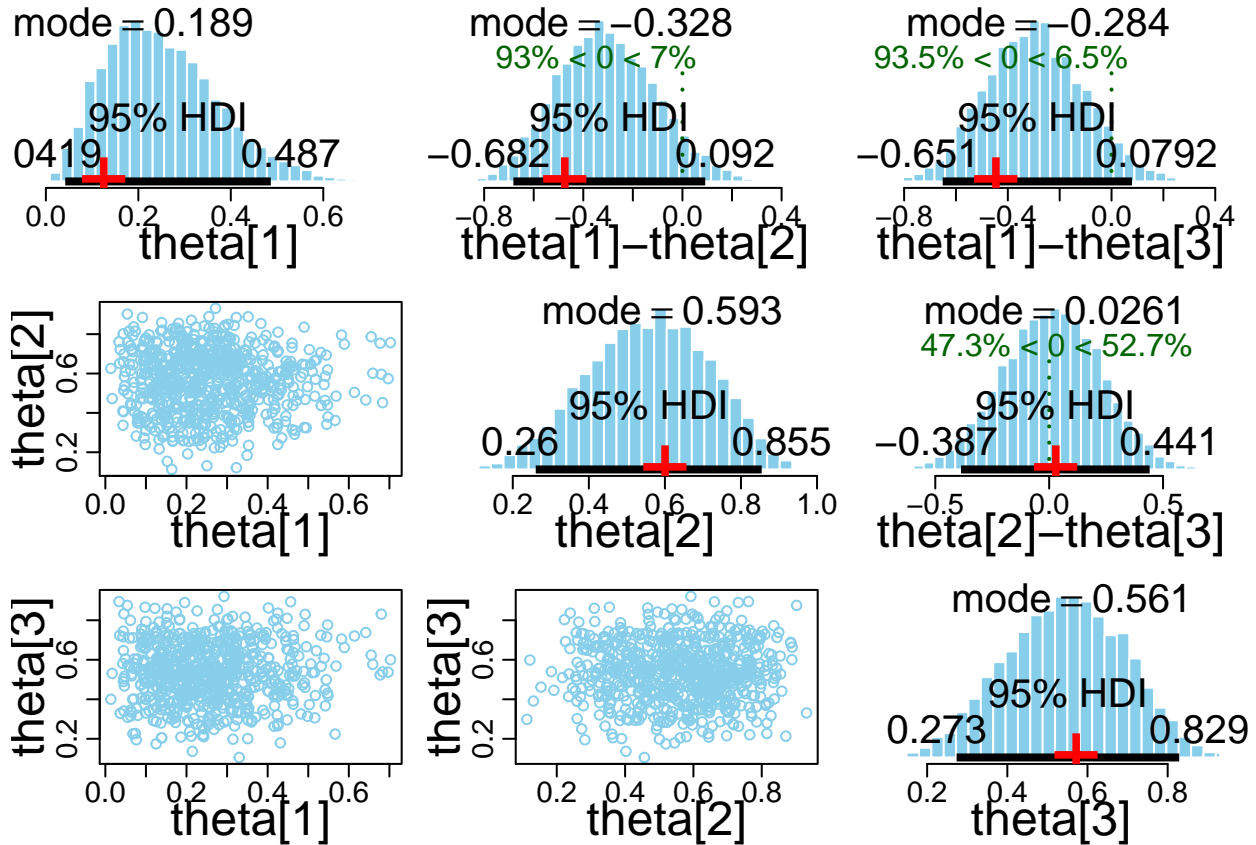
```
## theta[1]-theta[3] -0.29133936 -0.29484662 -0.28357501 10000.0    0.95
## theta[2]-theta[3]  0.01247458  0.01479967  0.02610817 10000.0    0.95
##                        HDIlow     HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]           0.04190476 0.48656064      NA            NA      NA       NA
## theta[2]           0.26037977 0.85454663      NA            NA      NA       NA
## theta[3]           0.27348257 0.82883707      NA            NA      NA       NA
## theta[1]-theta[2] -0.68208998 0.09198754       0          7.05      NA       NA
## theta[1]-theta[3] -0.65136794 0.07923732       0          6.54      NA       NA
## theta[2]-theta[3] -0.38696135 0.44108889       0         52.68      NA       NA
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                  NA         NA         NA
## theta[2]                  NA         NA         NA
## theta[3]                  NA         NA         NA
## theta[1]-theta[2]         NA         NA         NA
## theta[1]-theta[3]         NA         NA         NA
## theta[2]-theta[3]         NA         NA         NA
```
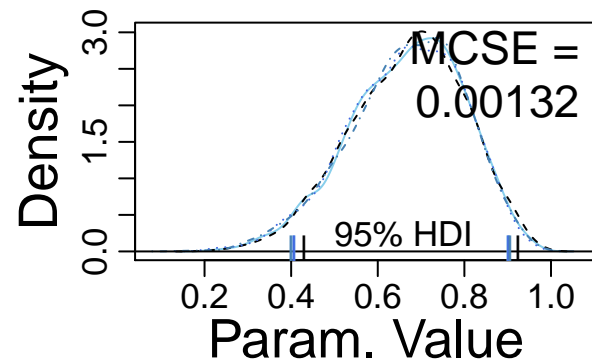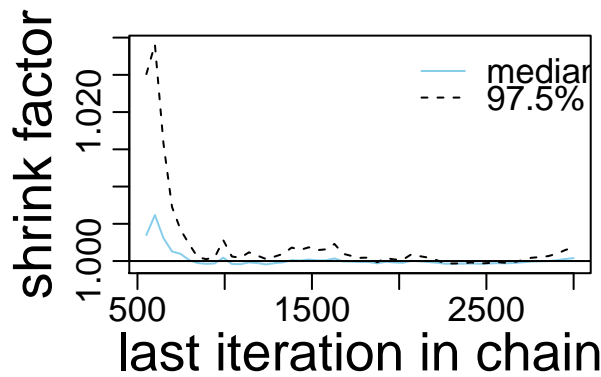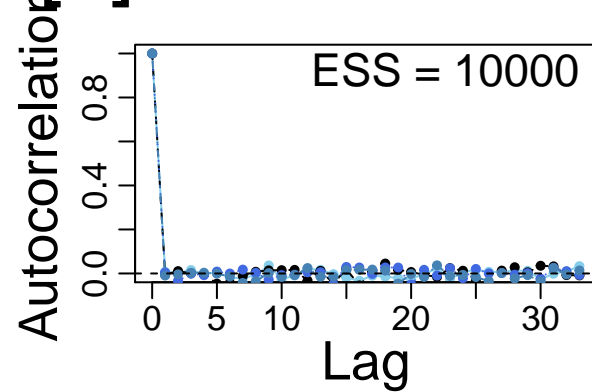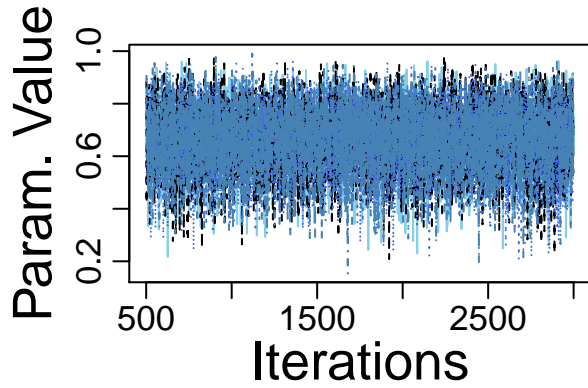
```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 15
##    Unobserved stochastic nodes: 2
##    Total graph size: 35
##
## Initializing model
##
```

theta[1]


```
##                  Mean    Median      Mode    ESS HDImass        HDIlow
## theta[1]       0.6669479 0.6773758 0.7313431 10000.0    0.95   0.41568096
## theta[2]       0.3639089 0.3553606 0.3342405 11984.5    0.95   0.11494832
## theta[1]-theta[2] 0.3030390 0.3131510 0.3411308 10000.0    0.95  -0.07705917
##                  HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh PcntLtROPE
## theta[1]       0.9150799      NA            NA      NA       NA         NA
## theta[2]       0.6323766      NA            NA      NA       NA         NA
## theta[1]-theta[2] 0.6639110       0          93.8      NA       NA         NA
##                  PcntInROPE PcntGtROPE
## theta[1]                NA         NA
## theta[2]                NA         NA
## theta[1]-theta[2]       NA         NA

##                  Mean    Median      Mode    ESS HDImass        HDIlow
## theta[1]       0.6669479 0.6773758 0.7313431 10000.0    0.95   0.41568096
## theta[2]       0.3639089 0.3553606 0.3342405 11984.5    0.95   0.11494832
## theta[1]-theta[2] 0.3030390 0.3131510 0.3411308 10000.0    0.95  -0.07705917
##                  HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh PcntLtROPE
## theta[1]       0.9150799      NA            NA      NA       NA         NA
## theta[2]       0.6323766      NA            NA      NA       NA         NA
## theta[1]-theta[2] 0.6639110       0          93.8      NA       NA         NA
##                  PcntInROPE PcntGtROPE
## theta[1]                NA         NA
## theta[2]                NA         NA
## theta[1]-theta[2]       NA         NA
```

The estimate are reasonable based on the above plots, which usually have wider HDI than 3 subjects with 9 plots in theta[1], theta[1]-theta[2] and theta[2].

Exercise 8.2

```
##                     Mean    Median      Mode     ESS HDImass      HDIlow
## theta[1]        0.6669479 0.6773758 0.7313431 10000.0    0.95  0.41568096
## theta[2]        0.3639089 0.3553606 0.3342405 11984.5    0.95  0.11494832
## theta[1]-theta[2] 0.3030390 0.3131510 0.3411308 10000.0    0.95 -0.07705917
##                   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh PcntLtROPE
## theta[1]        0.9150799     0.5         88.91    0.45     0.55       6.46
## theta[2]        0.6323766     0.5         16.89    0.45     0.55      73.42
## theta[1]-theta[2] 0.6639110     0.0         93.80   -0.05     0.05       4.00
##                 PcntInROPE PcntGtROPE
## theta[1]             12.74      80.80
## theta[2]             16.61       9.97
## theta[1]-theta[2]     5.87      90.13
```

The output differs in the numerical details due to randomness in the MCMC chain. Although the output includes many decimal places, most are not significant due to the sampling randomness in the MCMC chain; only the first few digits are stable, depending on the ESS.

Exercise 8.3

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 20
##    Unobserved stochastic nodes: 3
##    Total graph size: 46
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```
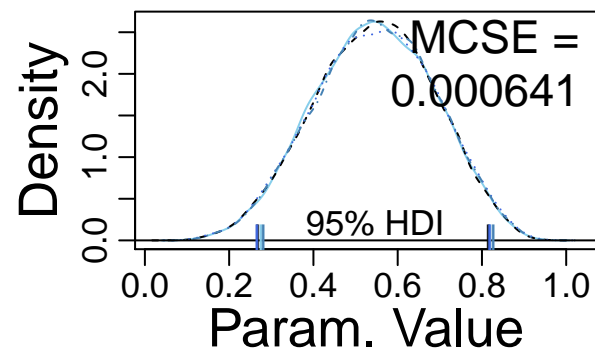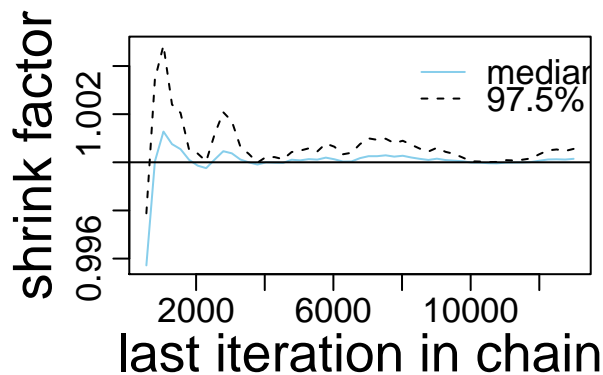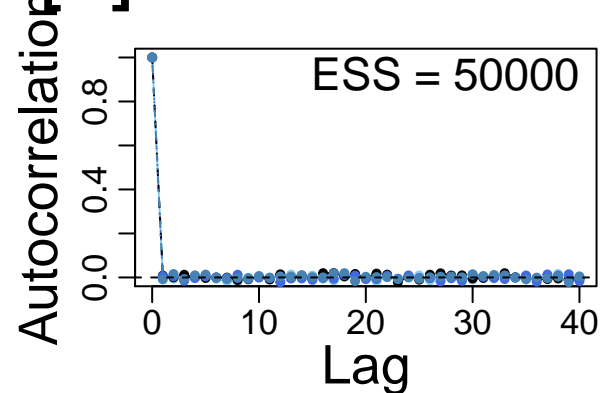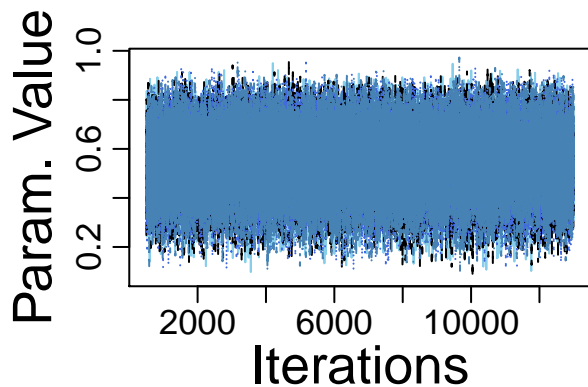


```
##                        Mean       Median        Mode      ESS HDImass
## theta[1]          0.250128541  0.23582085  0.19482757 48849.1    0.95
## theta[2]          0.554435312  0.55814411  0.56921135 50000.0    0.95
## theta[3]          0.546197533  0.54867776  0.55029224 50000.0    0.95
## theta[1]-theta[2] -0.304306771 -0.31152785 -0.32570919 50000.0   0.95
## theta[1]-theta[3] -0.296068992 -0.30210995 -0.32844757 50000.0   0.95
## theta[2]-theta[3]  0.008237779  0.00877992 -0.02093268 50000.0   0.95
##                       HDIlow    HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]          0.04246926 0.48534113     0.5         3.170    0.45     0.55
## theta[2]          0.25777679 0.85277254     0.5        63.286    0.45     0.55
## theta[3]          0.27507457 0.82356677     0.5        62.404    0.45     0.55
## theta[1]-theta[2] -0.68893095 0.07783905    0.0         6.912   -0.05     0.05
```

```
## theta[1]-theta[3] -0.64969877 0.07456616      0.0           6.188   -0.05      0.05
## theta[2]-theta[3] -0.40338277 0.41984552      0.0          51.560   -0.05      0.05
##                    PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]              93.488      5.042      1.470
## theta[2]              26.318     21.810     51.872
## theta[3]              26.028     24.350     49.622
## theta[1]-theta[2]     89.388      6.432      4.180
## theta[1]-theta[3]     89.938      6.308      3.754
## theta[2]-theta[3]     39.314     18.038     42.648

## pdf
##   2
```

From the above lines, the first one specifies the beginning of the filenames for saved information, and the second one specifies the graphics format for saved graphs.

The MCMC chain is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Mcmc.Rdata. Notice the name is the fileNameRoot with Mcmc appended. It is in compressed Rdata format.

The diagnostic graphs are saved in files named Jags-Ydich-XnomSsubj-MbernBeta-Diagtheta[1].eps and Jags-Ydich-XnomSsubj-MbernBeta-Diagtheta[2].eps

Exercise 8.4

(A)

```
## 
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## *********************************************************************
## Compiling model graph
##     Resolving undeclared variables
##     Allocating nodes
## Graph information:
##     Observed stochastic nodes: 15
##     Unobserved stochastic nodes: 2
##     Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```
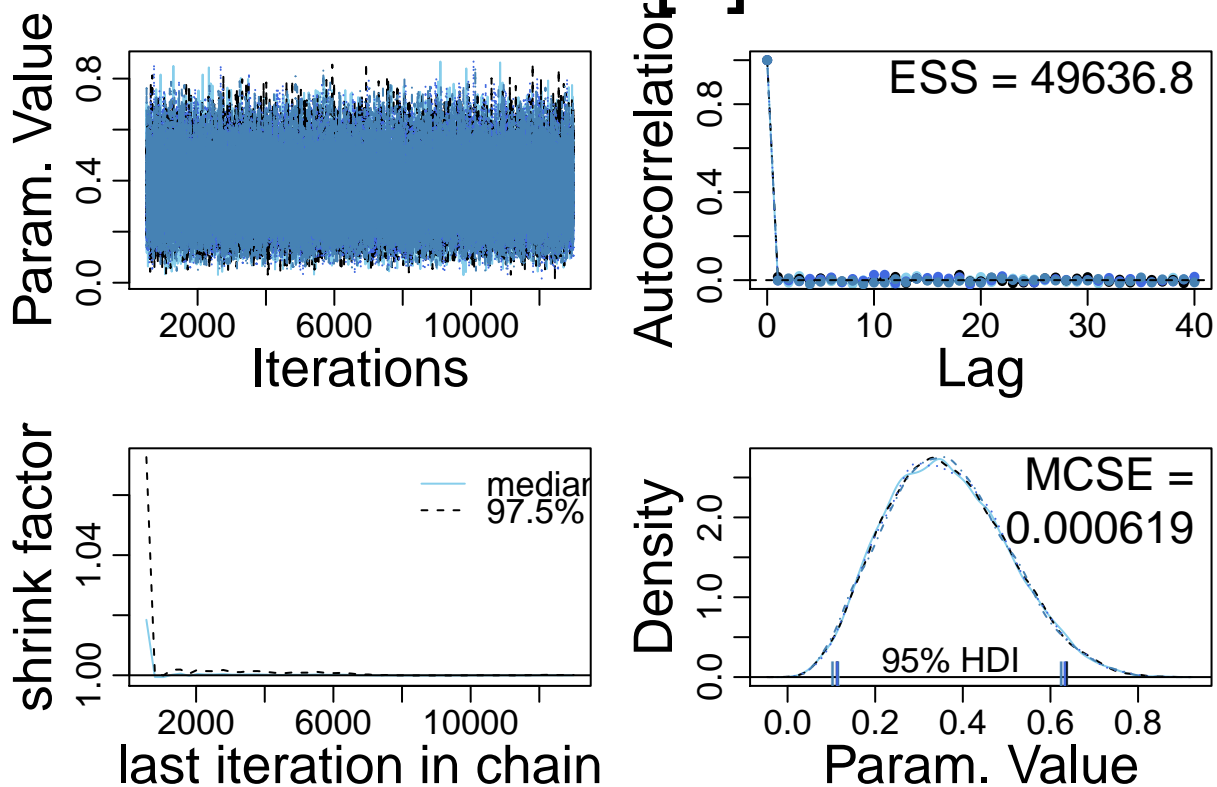


```
##                       Mean      Median      Mode       ESS  HDImass      HDIlow
## theta[1]         0.6658082   0.6752700  0.7025491   50000.0     0.95   0.4121921
## theta[2]         0.3629034   0.3548088  0.3418863   50000.0     0.95   0.1138444
## theta[1]-theta[2] 0.3029047  0.3094595  0.3555584   48183.8     0.95  -0.0762691
##                      HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh PcntLtROPE
```

9

```
## theta[1]          0.9109187     NA           NA    NA    NA    NA
## theta[2]          0.6356060     NA           NA    NA    NA    NA
## theta[1]-theta[2] 0.6603289      0       93.662    NA    NA    NA
##                   PcntInROPE PcntGtROPE
## theta[1]                  NA         NA
## theta[2]                  NA         NA
## theta[1]-theta[2]         NA         NA

## X11cairo
##        2
```

(B)

```
##
## **********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## **********************************************************************

## Compiling model graph
##     Resolving undeclared variables
##     Allocating nodes
## Graph information:
##     Observed stochastic nodes: 15
##     Unobserved stochastic nodes: 2
##     Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```
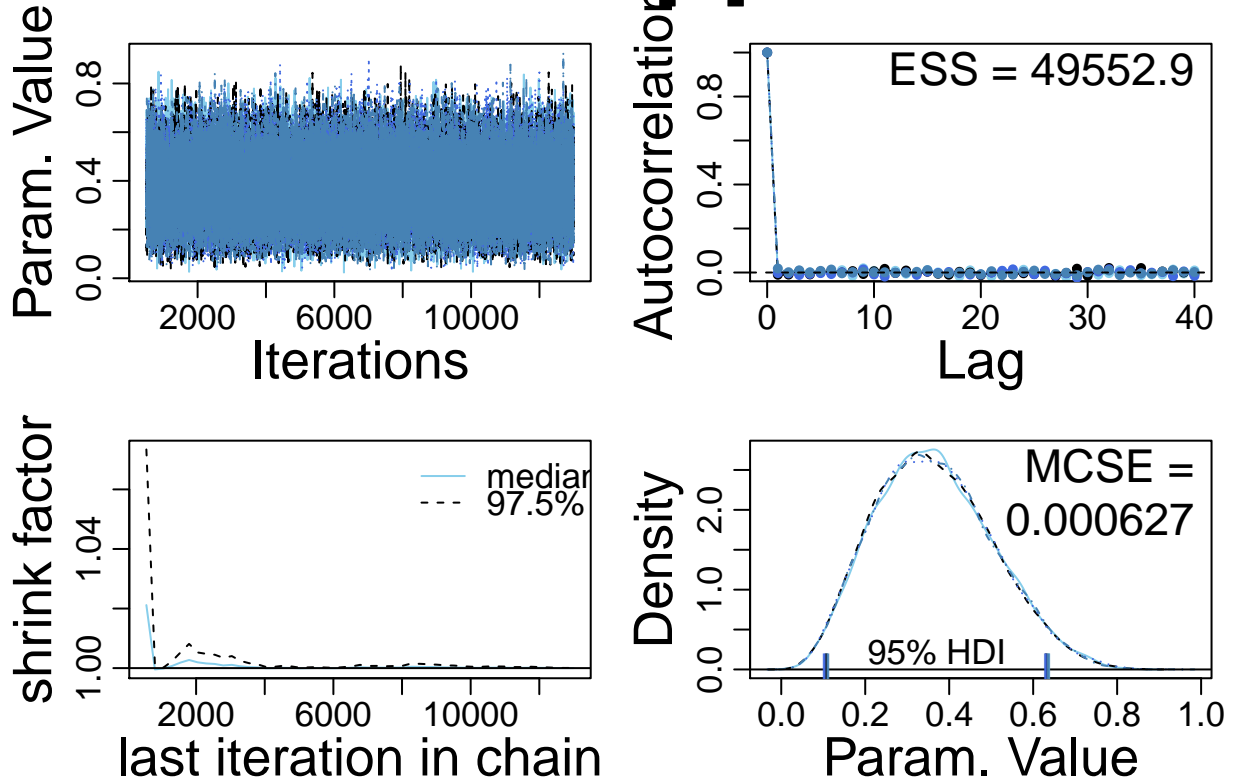
theta[2]


```
##                        Mean    Median       Mode    ESS HDImass       HDIlow
## theta[1]         0.6679846 0.6775703 0.6835721  50000    0.95   0.40901408
## theta[2]         0.3645124 0.3561741 0.3270791  50000    0.95   0.10778461
## theta[1]-theta[2] 0.3034722 0.3127111 0.3456843 50000    0.95  -0.08086931
##                       HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh PcntLtROPE
## theta[1]            0.9032328      NA            NA      NA       NA         NA
## theta[2]            0.6343745      NA            NA      NA       NA         NA
## theta[1]-theta[2]   0.6584032       0        93.496      NA       NA         NA
##                     PcntInROPE PcntGtROPE
## theta[1]                    NA         NA
## theta[2]                    NA         NA
## theta[1]-theta[2]           NA         NA

## X11cairo
##        2
```

In the file Jags-Ydich-XnomSsubj-MbernBeta.R, change the specification of the prior to dbeta(1,1) in line 36, then we run the script Jags-Ydich-XnomSsubj-MbernBeta-Example.R.

Notice that the distributions on theta[1] and theta[2] look uniform, as they should, because that is a dbeta(1,1) distribution.

(C)

```
##
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
```

```
## *********************************************************************
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 15
##    Unobserved stochastic nodes: 2
##    Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```
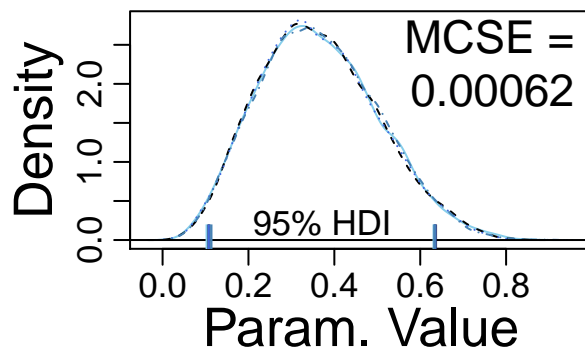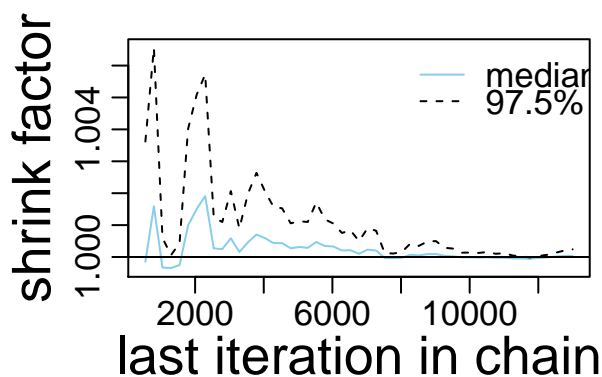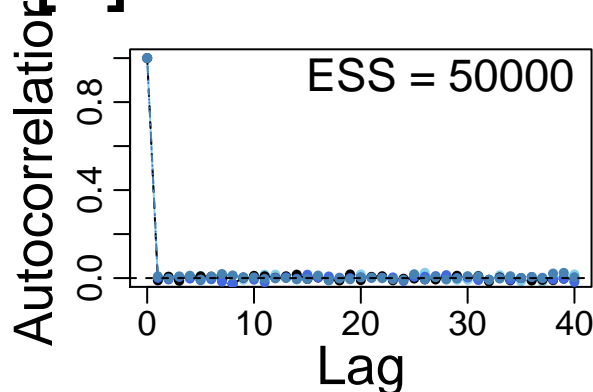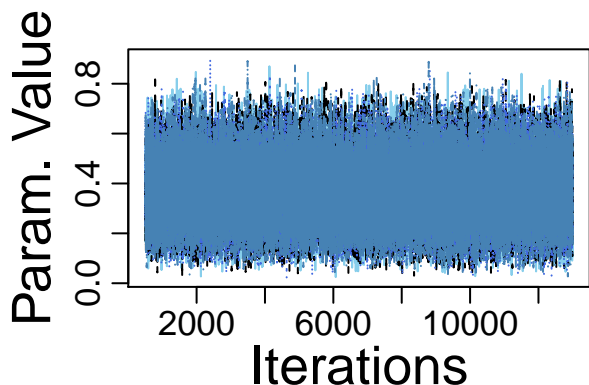

theta[2]

```
##                   Mean    Median      Mode   ESS HDImass      HDIlow
## theta[1]        0.6660748 0.6758011 0.6971051 50000   0.95  0.41115471
## theta[2]        0.3639859 0.3546860 0.3261677 50000   0.95  0.10811848
## theta[1]-theta[2] 0.3020888 0.3111489 0.3467912 50000   0.95 -0.07519048
##                   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh PcntLtROPE
## theta[1]        0.9075765      NA            NA      NA       NA         NA
## theta[2]        0.6346283      NA            NA      NA       NA         NA
## theta[1]-theta[2] 0.6606867       0        93.508      NA       NA         NA
##                   PcntInROPE PcntGtROPE
## theta[1]                  NA         NA
## theta[2]                  NA         NA
## theta[1]-theta[2]          NA         NA
```

```
## X11cairo
##       2
```

In the file Jags-Ydich-XnomSsubj-MbernBeta.R, change the specification of the prior to dbeta(1,1), then we run the script Jags-Ydich-XnomSsubj-MbernBeta-Example.R.