

# MA677 Assignment JAGS

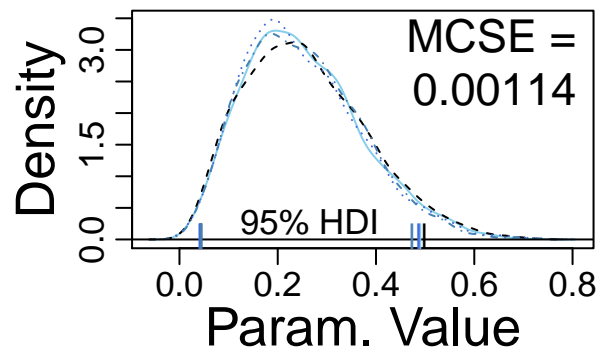
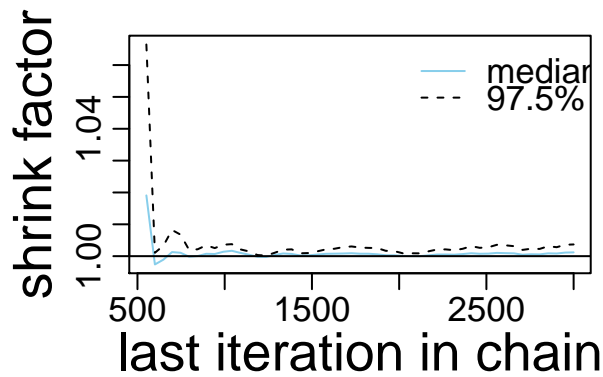
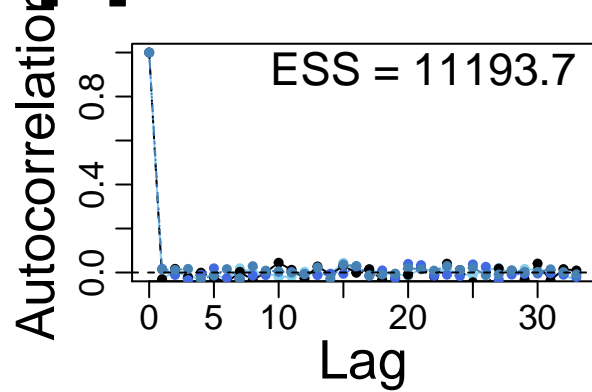
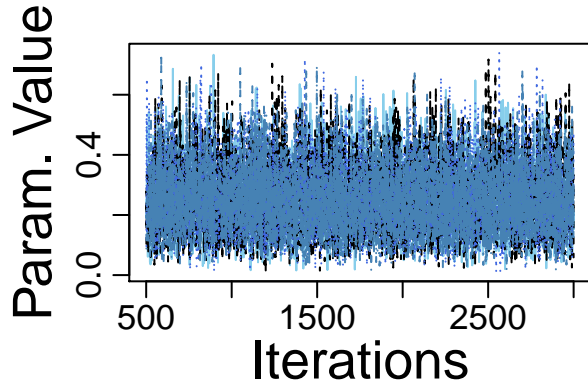
Yiping Jiang

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]

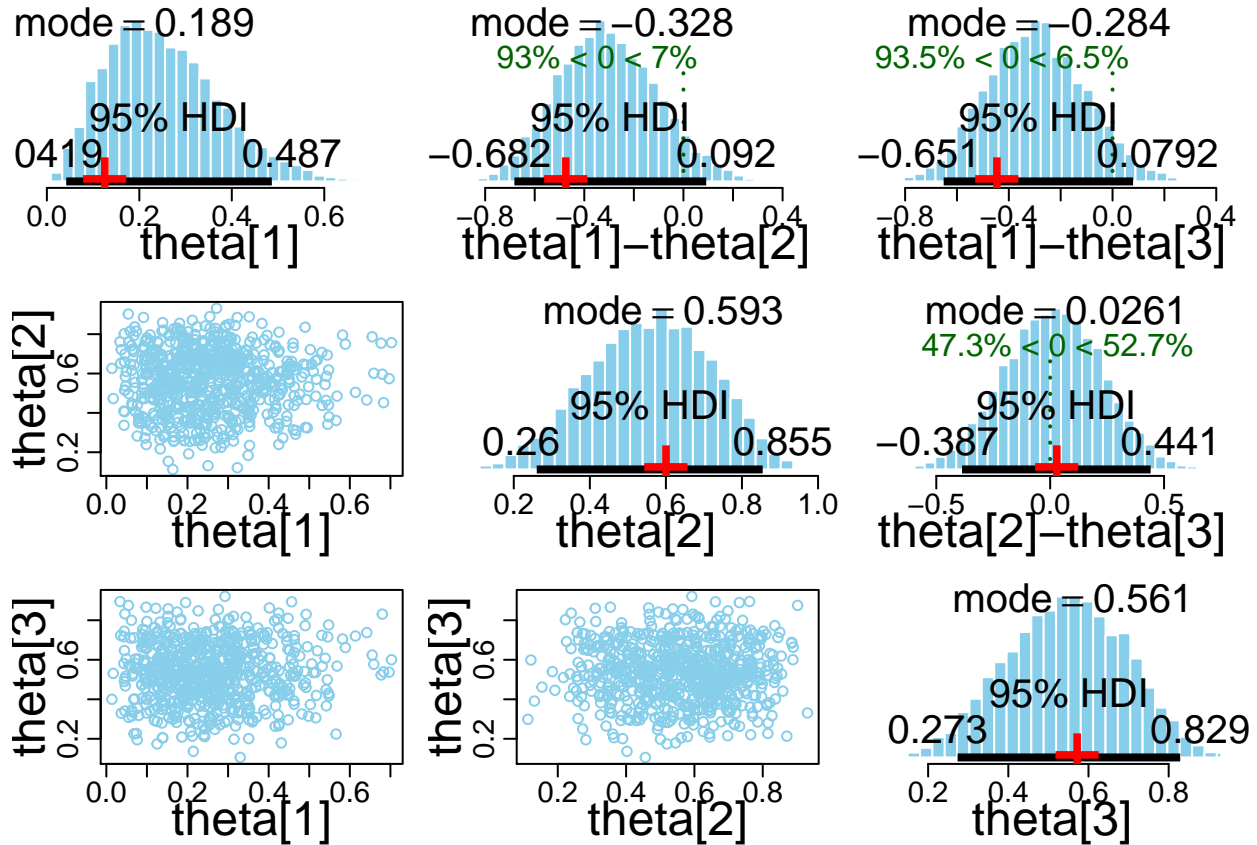


##	Mean	Median	Mode	ESS	HDImass		
## theta[1]	0.25315187	0.23952342	0.18905822	10000.0	0.95		
## theta[2]	0.55696581	0.56194355	0.59256203	10000.0	0.95		
## theta[3]	0.54449123	0.54800260	0.56119375	9861.8	0.95		
## theta[1]-theta[2]	-0.30381394	-0.31304991	-0.32802751	10000.0	0.95		
## theta[1]-theta[3]	-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

```



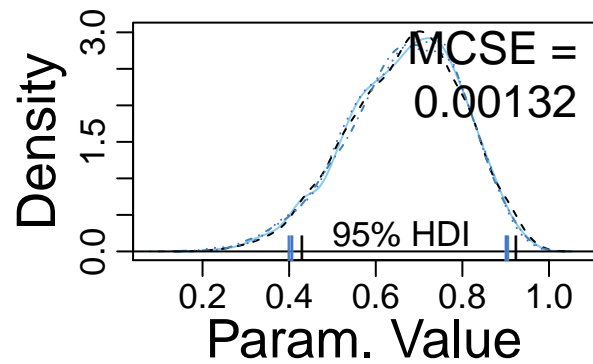
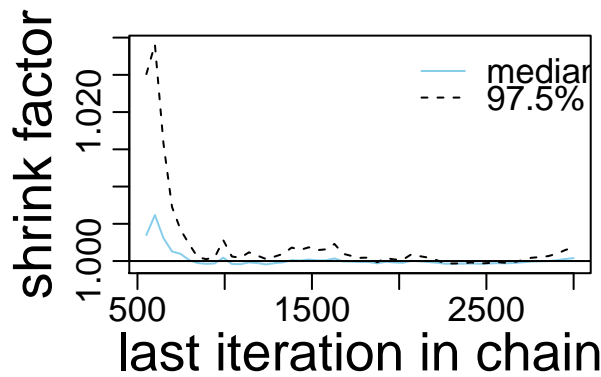
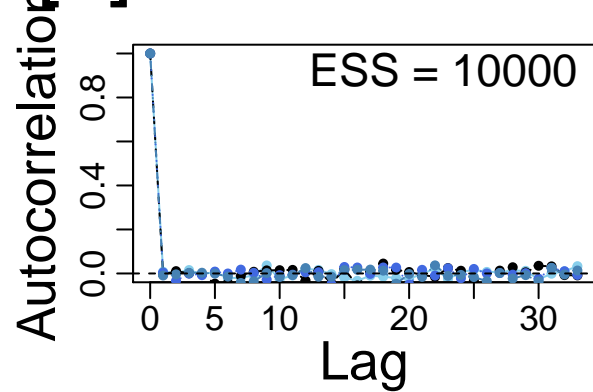
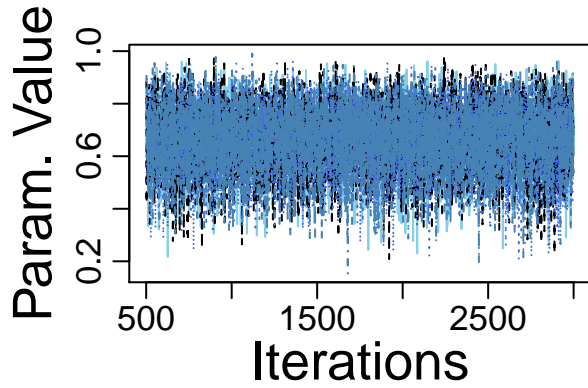
```

## Compiling model graph
##   Resolving undeclared variables
##   Allocating nodes
## Graph information:
##   Observed stochastic nodes: 15
##   Unobserved stochastic nodes: 2
##   Total graph size: 35
##
## Initializing model
##

```

```
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

# 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

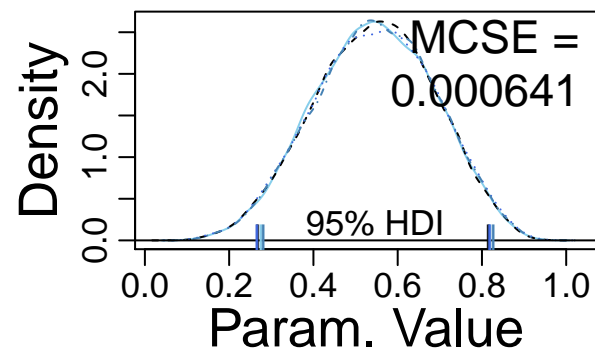
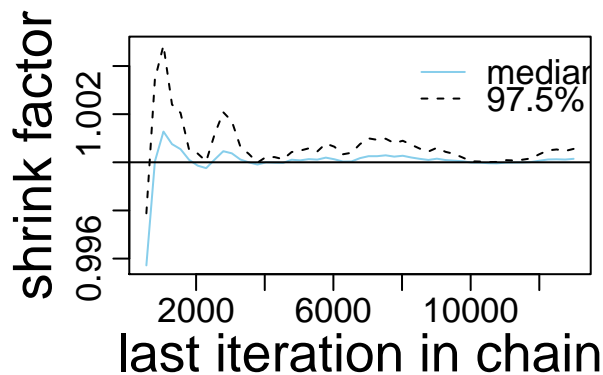
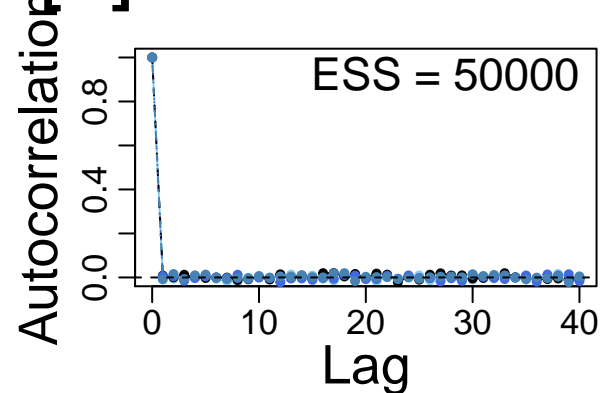
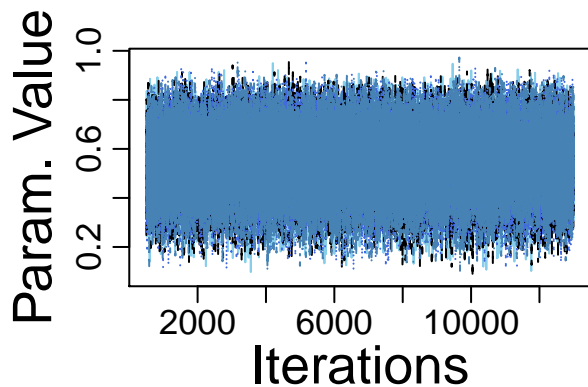
```
##               Mean      Median      Mode      ESS HDImass      HDIlow
## theta[1]      0.6669479 0.6773758 0.7313431 10000.0    0.95 0.41568096
## theta[2]      0.3639089 0.3553606 0.3342405 11984.5    0.95 0.11494832
## theta[1]-theta[2] 0.3030390 0.3131510 0.3411308 10000.0    0.95 -0.07705917
##               HDIhigh CompVal PcmtGtCompVal ROPElow ROPEhigh PcmtLtROPE
## 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
##               PcmtInROPE PcmtGtROPE
## 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...
```

theta[3]



	Mean	Median	Mode	ESS	HDI	mass
## 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



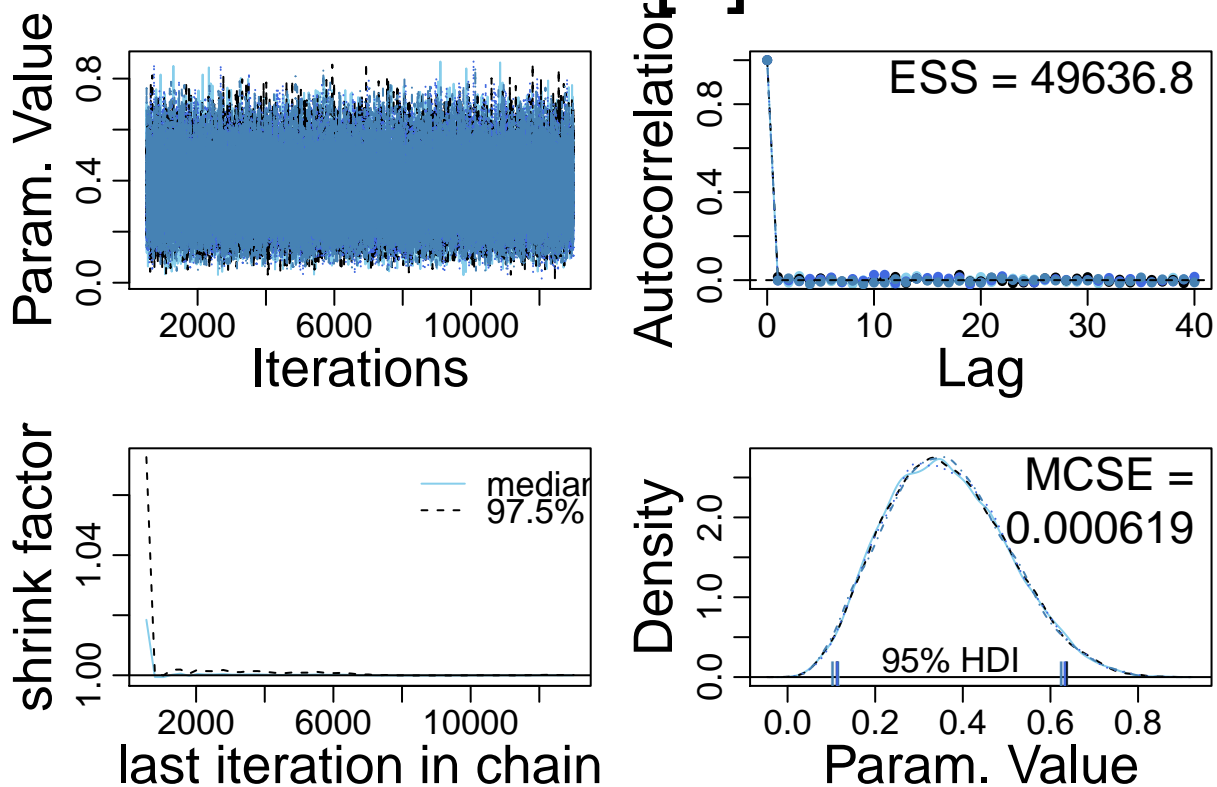
## Exercise 8.4

(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...
```

theta[2]



	Mean	Median	Mode	ESS	HDImass	HDIlow	HDIhigh	CompVal	PcntGtCompVal	ROPElow	ROPEhigh	PcntLtROPE
## 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						
##												

```
## 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

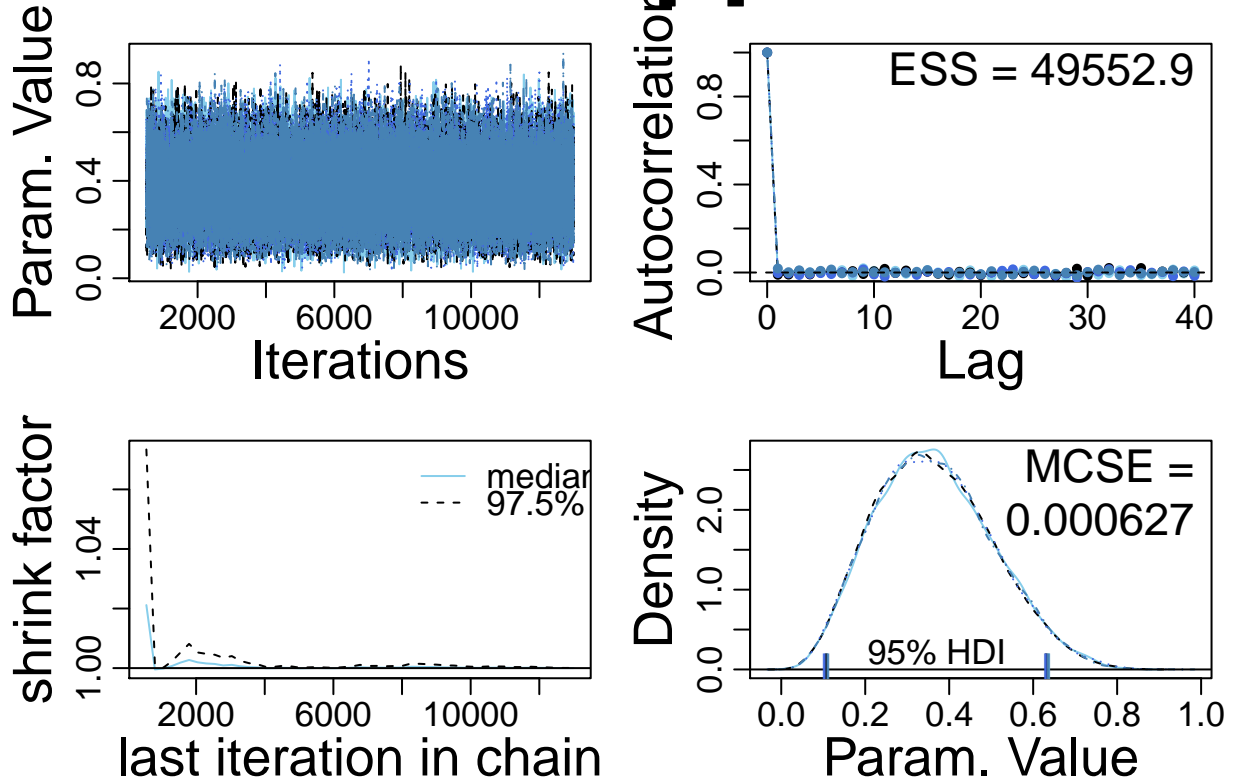
## X11cairo
##          2
```

(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`.

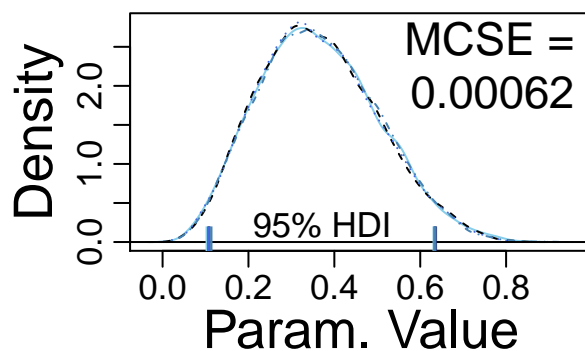
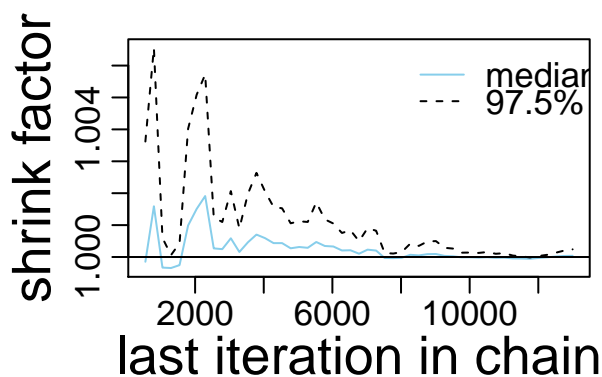
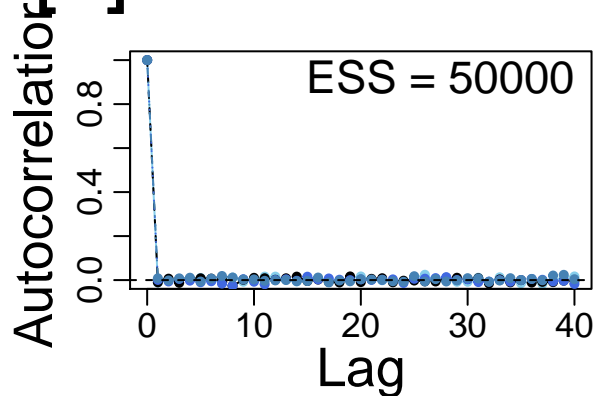
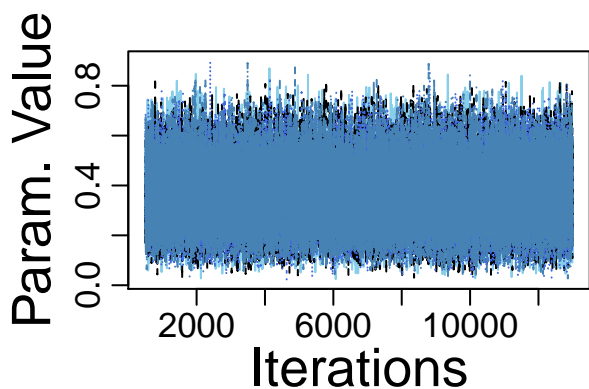
Notice that the distributions on  $\theta[1]$  and  $\theta[2]$  look uniform, as they should, because that is a `dbeta(1,1)` distribution.

(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.