MA677 Homework

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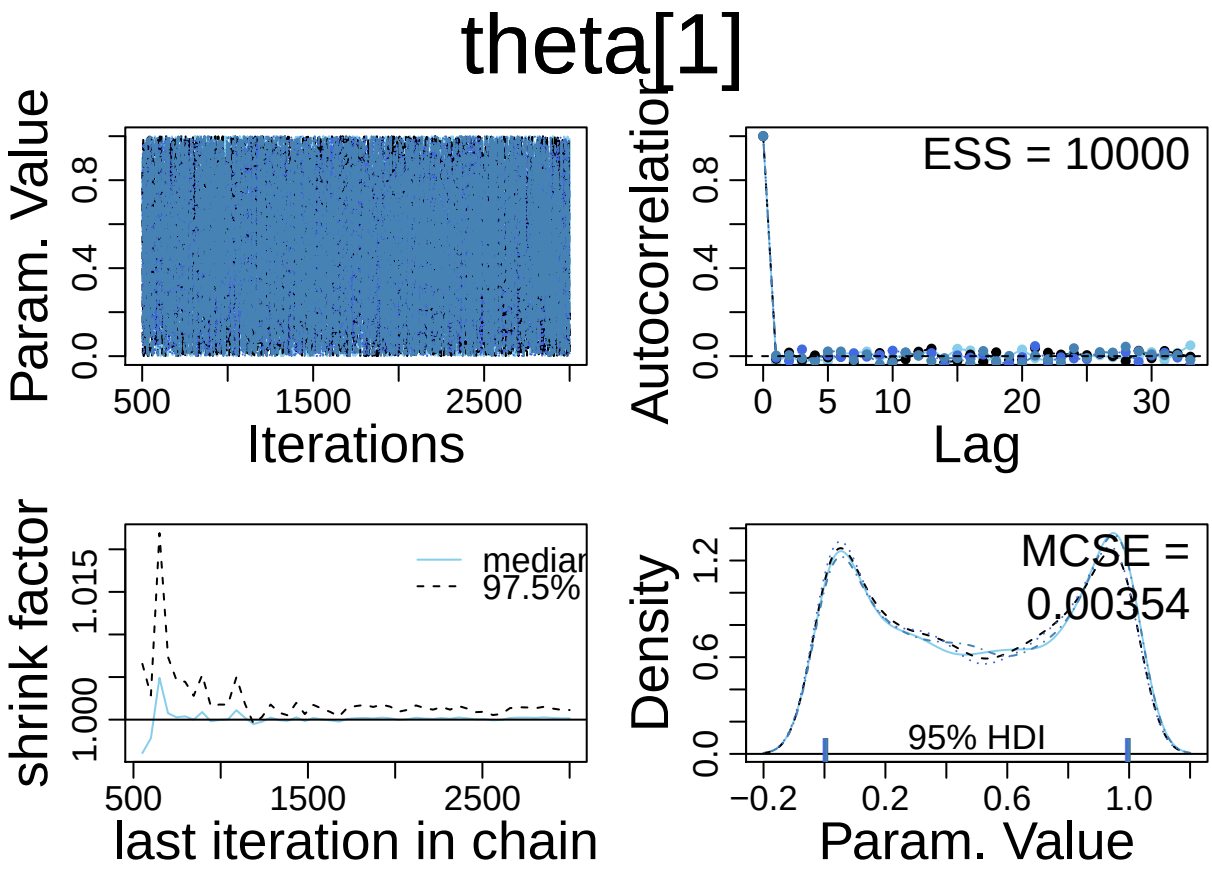
4/12/2020

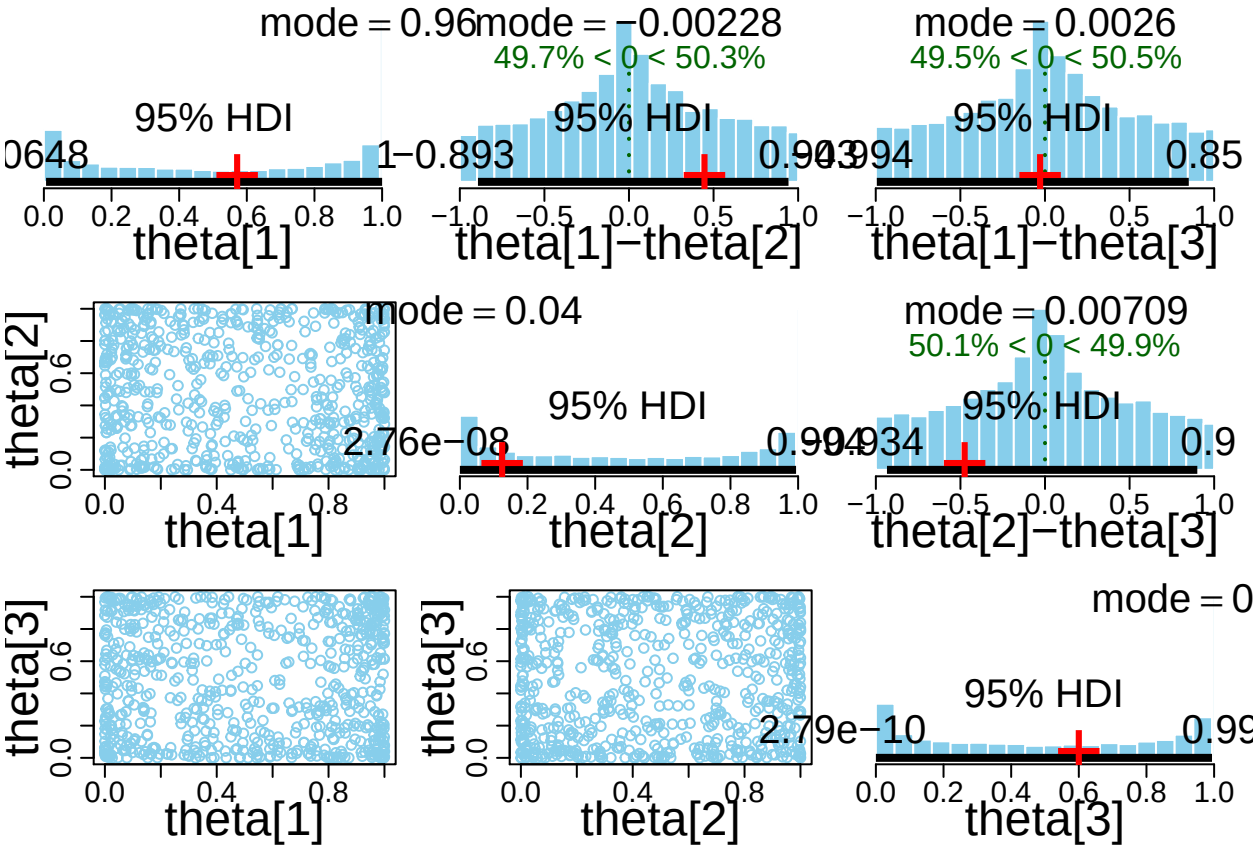
Exercise 8.1

```
##
## ************************************************************************
## 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: 0
##    Unobserved stochastic nodes: 23
##    Total graph size: 46
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

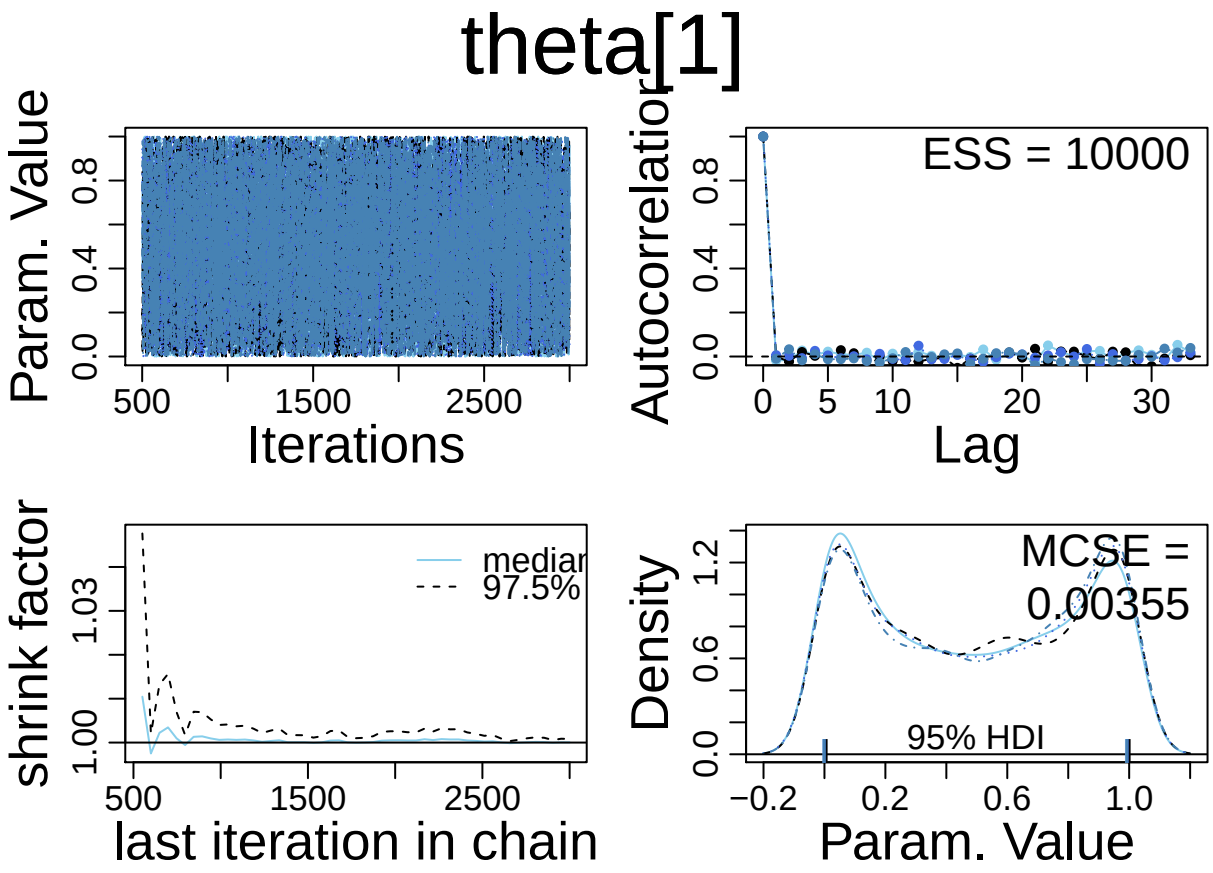


```
##                          Mean        Median          Mode     ESS HDImass
## theta[1]           0.503210033  0.4981907825  0.960178722 10000.0    0.95
## theta[2]           0.496415144  0.4877160782  0.039995490 10319.4    0.95
## theta[3]           0.500825531  0.4982023447  0.959992371 10499.1    0.95
## theta[1]-theta[2]  0.006794888  0.0016904151 -0.002278489  9706.6    0.95
## theta[1]-theta[3]  0.002384502  0.0034312114  0.002596201 10000.0    0.95
## theta[2]-theta[3] -0.004410387 -0.0005028048  0.007093929 10000.0    0.95
##                         HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]           6.478279e-03 0.9999998      NA            NA      NA
## theta[2]           2.758785e-08 0.9939336      NA            NA      NA
## theta[3]           2.794677e-10 0.9937419      NA            NA      NA
## theta[1]-theta[2] -8.927565e-01 0.9430403       0         50.31      NA
## theta[1]-theta[3] -9.937840e-01 0.8499276       0         50.46      NA
## theta[2]-theta[3] -9.342798e-01 0.9004818       0         49.86      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[3]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         NA         NA
## theta[1]-theta[3]       NA         NA         NA         NA
## theta[2]-theta[3]       NA         NA         NA         NA
```

```
##                          Mean        Median          Mode     ESS HDImass
## theta[1]           0.503210033  0.4981907825  0.960178722 10000.0    0.95
## theta[2]           0.496415144  0.4877160782  0.039995490 10319.4    0.95
## theta[3]           0.500825531  0.4982023447  0.959992371 10499.1    0.95
## theta[1]-theta[2]  0.006794888  0.0016904151 -0.002278489  9706.6    0.95
## theta[1]-theta[3]  0.002384502  0.0034312114  0.002596201 10000.0    0.95
## theta[2]-theta[3] -0.004410387 -0.0005028048  0.007093929 10000.0    0.95
##                         HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]           6.478279e-03 0.9999998      NA            NA      NA
## theta[2]           2.758785e-08 0.9939336      NA            NA      NA
## theta[3]           2.794677e-10 0.9937419      NA            NA      NA
## theta[1]-theta[2] -8.927565e-01 0.9430403       0         50.31      NA
## theta[1]-theta[3] -9.937840e-01 0.8499276       0         50.46      NA
## theta[2]-theta[3] -9.342798e-01 0.9004818       0         49.86      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[3]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         NA         NA
## theta[1]-theta[3]       NA         NA         NA         NA
## theta[2]-theta[3]       NA         NA         NA         NA
```




```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 0
##    Unobserved stochastic nodes: 17
##    Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```




```
##                          Mean       Median         Mode     ESS HDImass
## theta[1]            0.49830437  0.501812167  0.036928788 10000.0    0.95
## theta[2]            0.50071019  0.492435914  0.960026651 10536.3    0.95
## theta[1]-theta[2] -0.00240582 -0.002682452 -0.002502254 10000.0    0.95
##                          HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]            5.182126e-08 0.9936929      NA            NA      NA
## theta[2]            3.406279e-09 0.9936104      NA            NA      NA
## theta[1]-theta[2] -9.818766e-01 0.8643602       0         49.58      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         NA         NA
```

```
##                          Mean       Median         Mode     ESS HDImass
## theta[1]            0.49830437  0.501812167  0.036928788 10000.0    0.95
## theta[2]            0.50071019  0.492435914  0.960026651 10536.3    0.95
## theta[1]-theta[2] -0.00240582 -0.002682452 -0.002502254 10000.0    0.95
##                          HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]            5.182126e-08 0.9936929      NA            NA      NA
## theta[2]            3.406279e-09 0.9936104      NA            NA      NA
## theta[1]-theta[2] -9.818766e-01 0.8643602       0         49.58      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         NA         NA
```

2 subjects with 4 plots usually has wider HDI than 3 subjects with 9 plots in theta[1], theta[1]-thera[2] and theta[2].

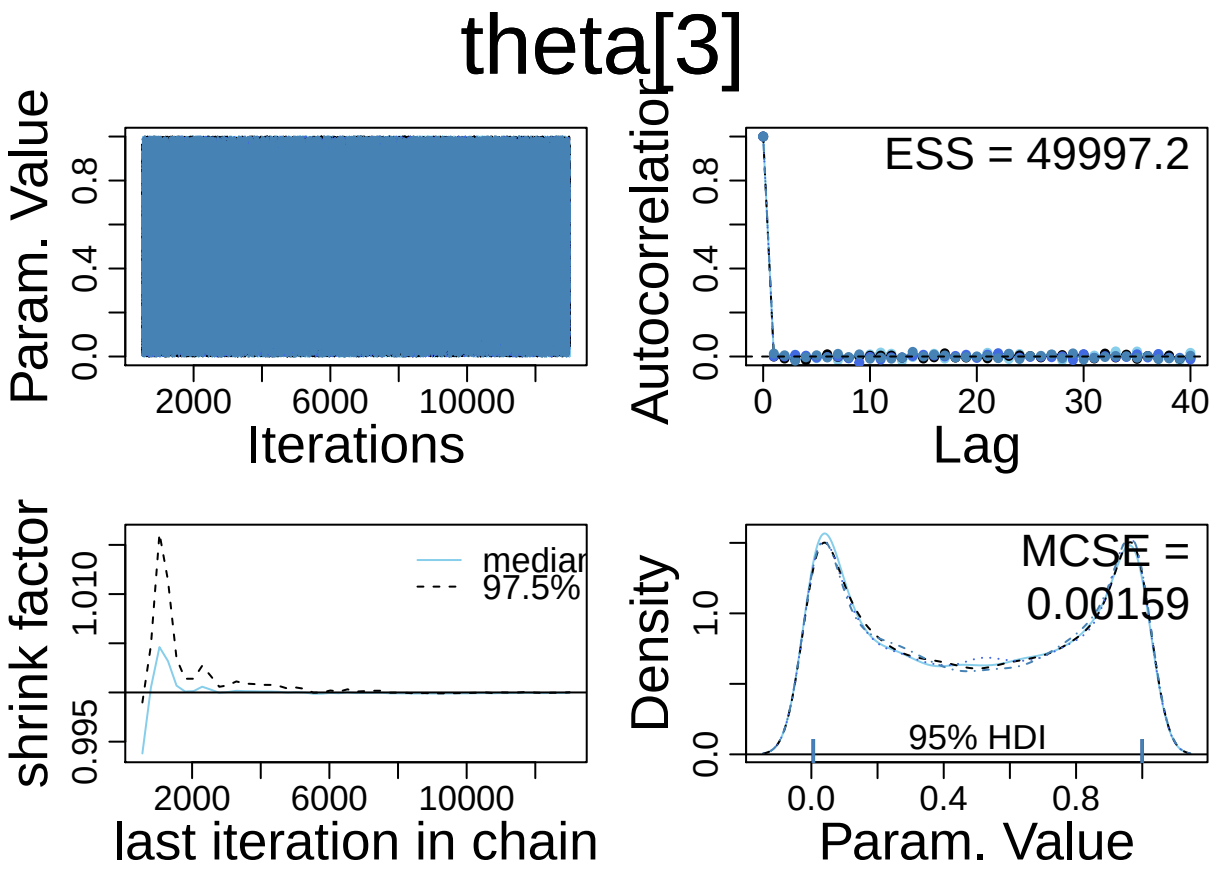
Exercise 8.2

```
##                          Mean       Median          Mode     ESS HDImass
## theta[1]           0.49830437  0.501812167  0.036928788 10000.0    0.95
## theta[2]           0.50071019  0.492435914  0.960026651 10536.3    0.95
## theta[1]-theta[2] -0.00240582 -0.002682452 -0.002502254 10000.0    0.95
##                         HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]           5.182126e-08 0.9936929     0.5         50.09    0.45
## theta[2]           3.406279e-09 0.9936104     0.5         49.51    0.45
## theta[1]-theta[2] -9.818766e-01 0.8643602     0.0         49.58   -0.05
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]              0.55      46.87       5.96      47.17
## theta[2]              0.55      47.33       6.00      46.67
## theta[1]-theta[2]     0.05      44.82      11.04      44.14
```

Due to the randomness in the MCMC chain, most results are not significant.

Exercise 8.3

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 0
##    Unobserved stochastic nodes: 23
##    Total graph size: 46
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

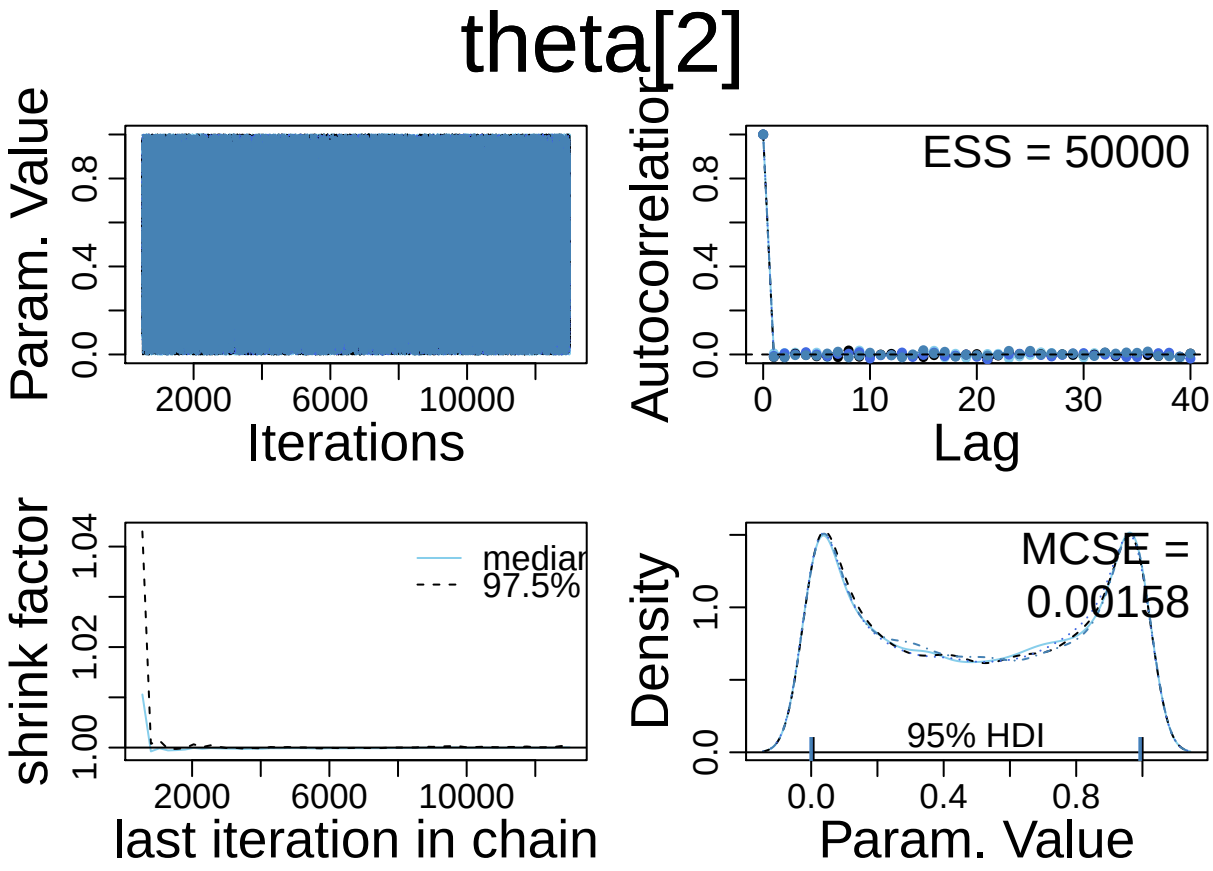



```
##                            Mean        Median         Mode     ESS HDImass
## theta[1]           0.5009925121  5.052150e-01  0.969097699 51369.8    0.95
## theta[2]           0.4995004694  4.995793e-01  0.971452569 50000.0    0.95
## theta[3]           0.5005325784  5.019473e-01  0.028489098 50000.0    0.95
## theta[1]-theta[2]  0.0014920427  7.239435e-04 -0.002291264 50000.0    0.95
## theta[1]-theta[3]  0.0004599337  3.039606e-04  0.002275811 50000.0    0.95
## theta[2]-theta[3] -0.0010321090 -5.395303e-05  0.002247879 50000.0    0.95
##                          HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]           2.278286e-09 0.9937367     0.5         50.298    0.45
## theta[2]           6.238826e-03 1.0000000     0.5         49.978    0.45
## theta[3]           6.429727e-03 1.0000000     0.5         50.134    0.45
## theta[1]-theta[2] -9.656614e-01 0.8845686     0.0         50.140   -0.05
## theta[1]-theta[3] -9.127721e-01 0.9327764     0.0         50.068   -0.05
## theta[2]-theta[3] -9.181882e-01 0.9253922     0.0         49.984   -0.05
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]              0.55     46.610      6.240     47.150
## theta[2]              0.55     46.962      6.292     46.746
## theta[3]              0.55     46.768      6.236     46.996
## theta[1]-theta[2]     0.05     44.480     10.796     44.724
## theta[1]-theta[3]     0.05     44.598     10.748     44.654
## theta[2]-theta[3]     0.05     44.558     11.036     44.406

## pdf
##   2
```

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: 0
##    Unobserved stochastic nodes: 17
##    Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```




```
##                          Mean       Median        Mode     ESS HDImass
## theta[1]           0.499715778 0.4960633575 0.971374637 50000.0    0.95
## theta[2]           0.498742953 0.4954764454 0.028792918 50000.0    0.95
## theta[1]-theta[2] 0.000972825 0.0007109219 0.002262407 50907.9    0.95
##                          HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
```

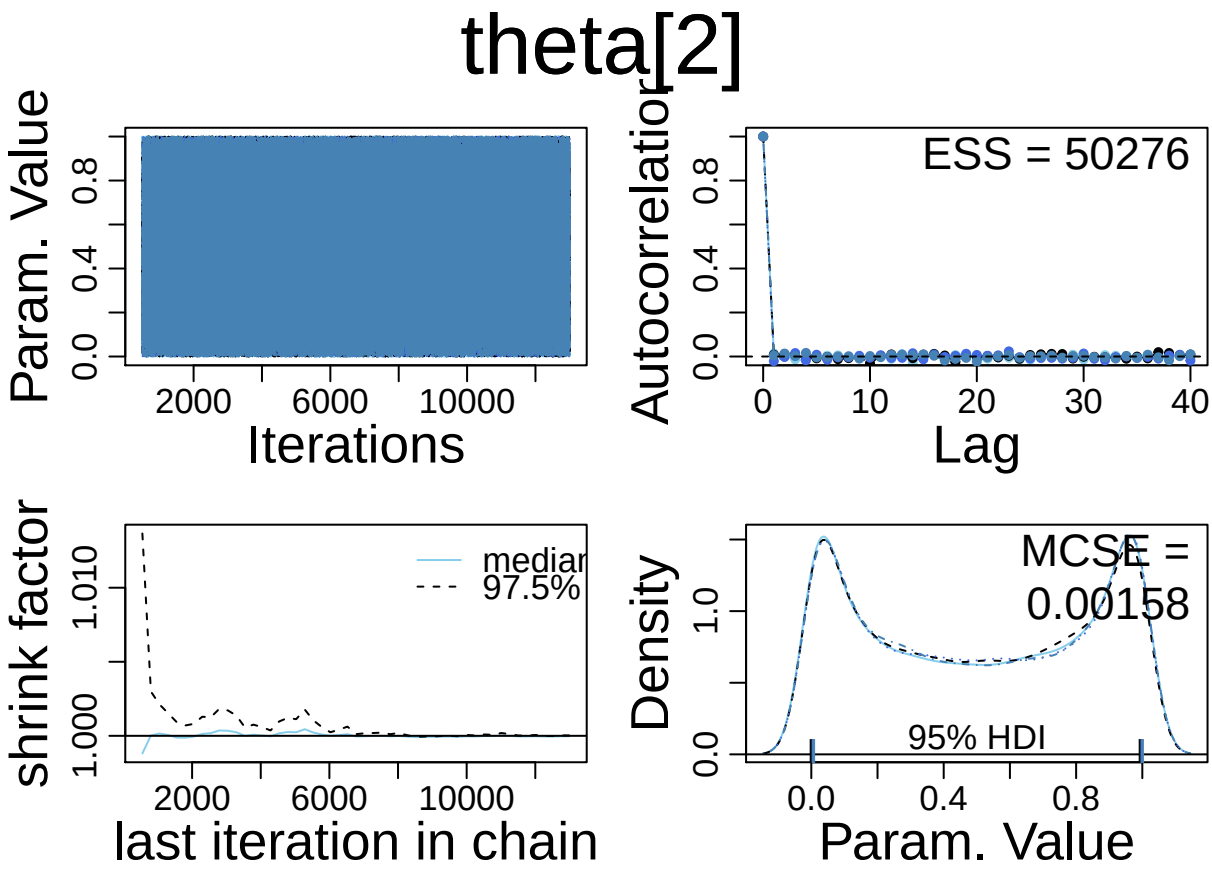
```
## theta[1]           6.394757e-03 1.0000000      NA            NA      NA
## theta[2]           1.482867e-11 0.9936264      NA            NA      NA
## theta[1]-theta[2] -9.205026e-01 0.9185818       0        50.124      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         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: 0
##    Unobserved stochastic nodes: 17
##    Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

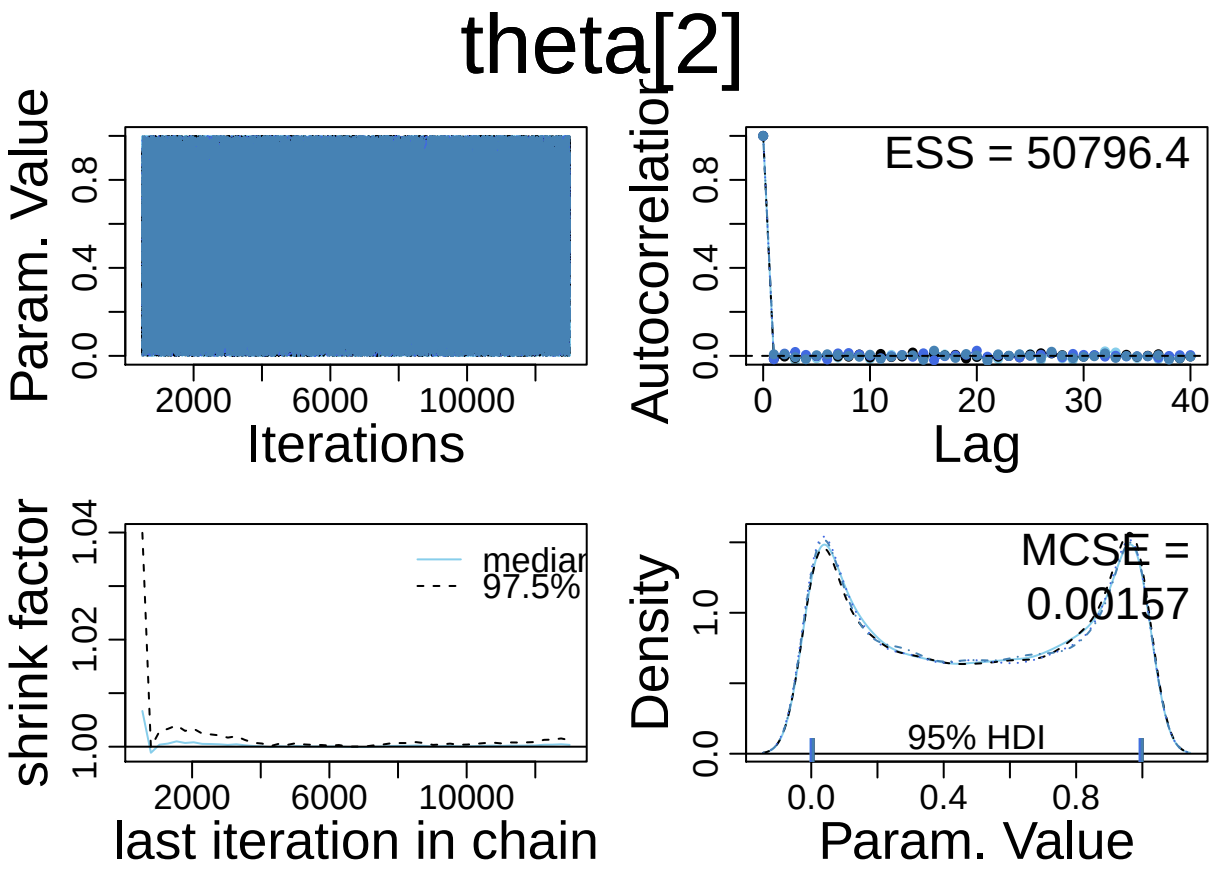



```
##                           Mean        Median          Mode   ESS HDImass
## theta[1]           0.499273216  0.4990885401  0.028630438 50000    0.95
## theta[2]           0.500586357  0.5004752415  0.971272452 50000    0.95
## theta[1]-theta[2] -0.001313141 -0.0009107756 -0.002246945 50000    0.95
##                          HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]           1.101429e-11 0.9937253      NA            NA      NA
## theta[2]           6.310333e-03 1.0000000      NA            NA      NA
## theta[1]-theta[2] -9.416131e-01 0.9040507       0        49.796      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         NA         NA

## X11cairo
##        2
```

(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: 0
```

```
##    Unobserved stochastic nodes: 17
##    Total graph size: 35
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```




```
##                          Mean       Median        Mode     ESS HDImass
## theta[1]           0.497043704  0.492902274 0.028661138 50710.0    0.95
## theta[2]           0.500783168  0.501980800 0.971228461 50863.5    0.95
## theta[1]-theta[2] -0.003739465 -0.000818411 0.002243863 51167.2    0.95
##                         HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow
## theta[1]           3.052387e-09 0.9938936      NA            NA      NA
## theta[2]           1.064706e-10 0.9940019      NA            NA      NA
## theta[1]-theta[2] -9.813393e-01 0.8623172       0        49.834      NA
##                   ROPEhigh PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                NA         NA         NA         NA
## theta[2]                NA         NA         NA         NA
## theta[1]-theta[2]       NA         NA         NA         NA

## X11cairo
##        2
```