MCMC Diagnostics - IFLS data

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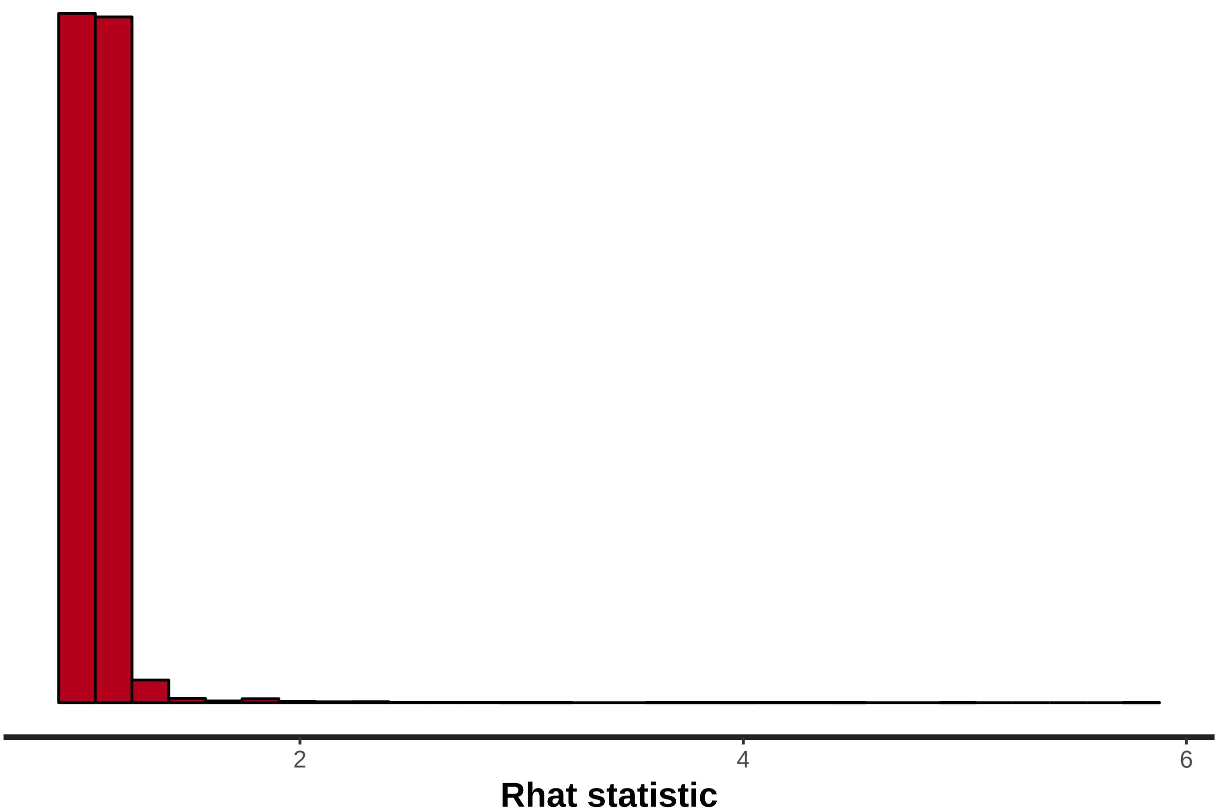
```r
K <- 7
Ti <- 3
N <- 1973
```

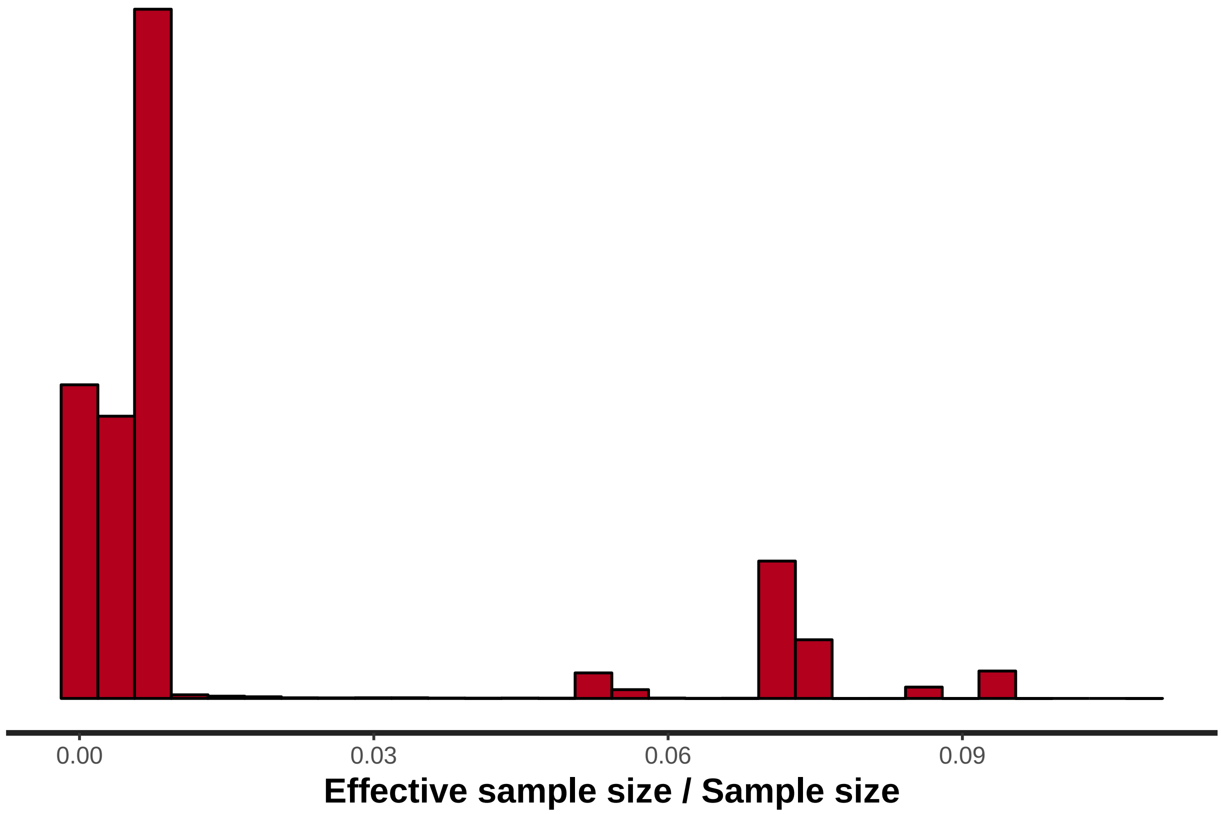
General MCMC diagnostic plots

Overall model diagnostics from rstan package.

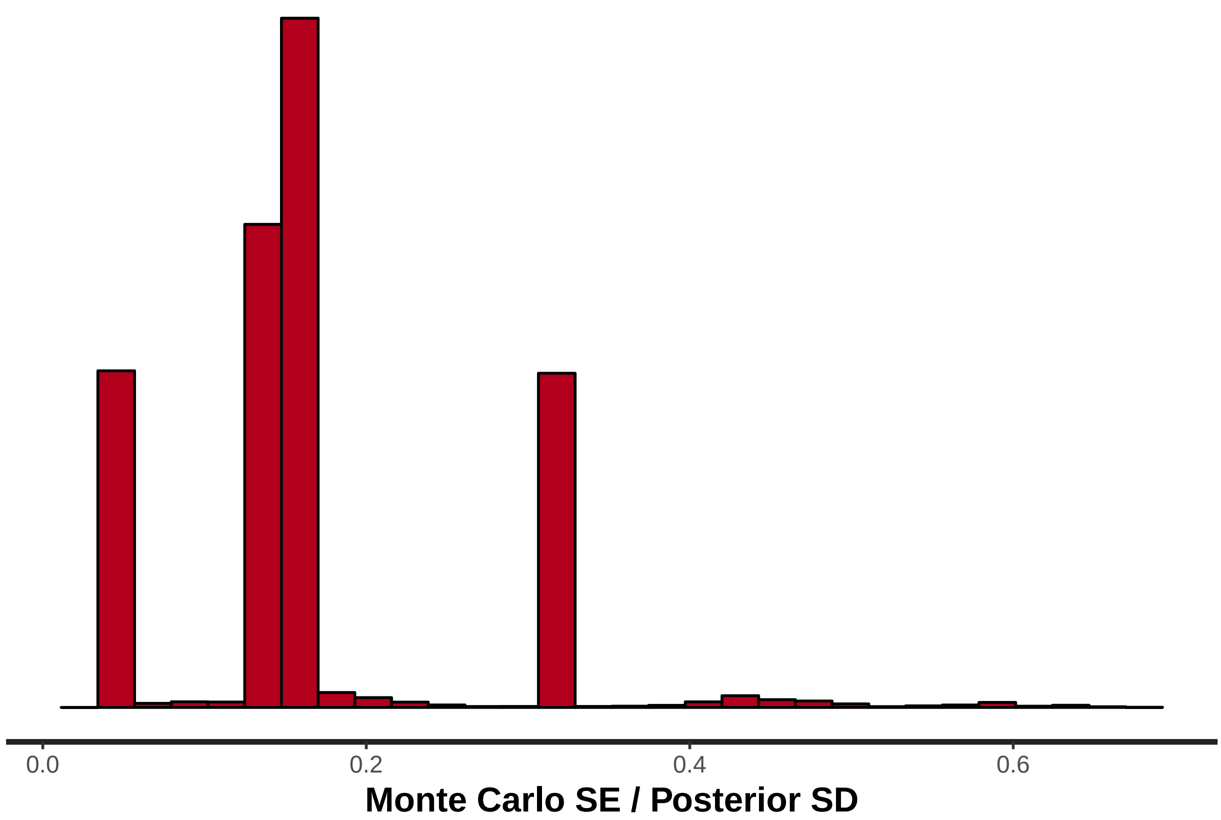
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



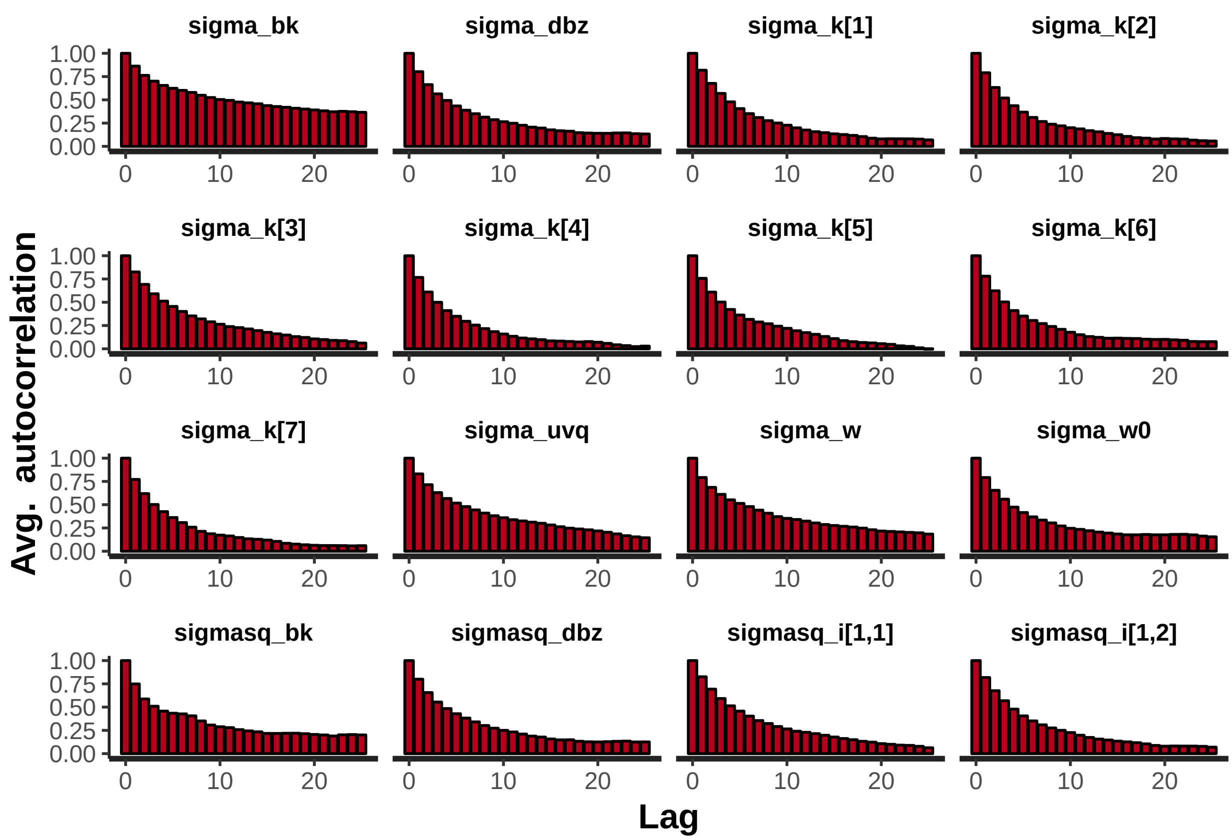
Individual Parameter Diagnostics

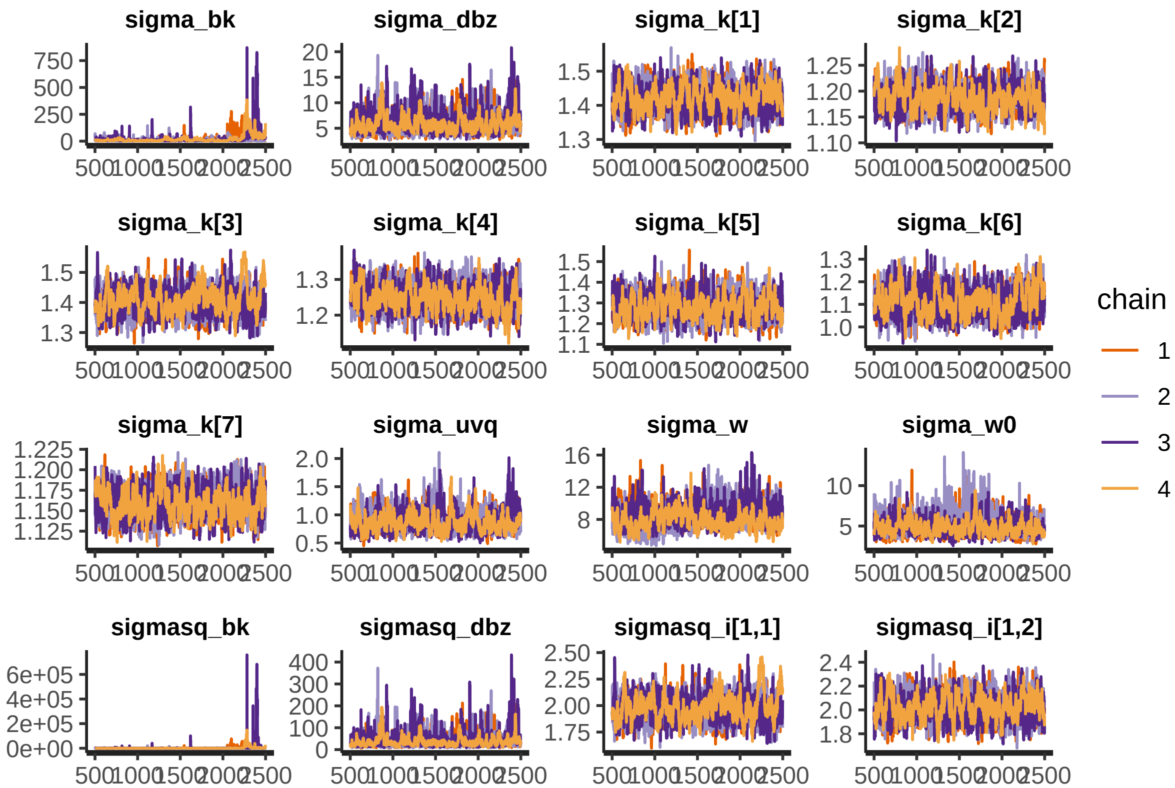
Individual parameter plots. Autocorrelation and trace plots for individual parameters, and histograms of posterior medians for group parameters.

```
get_single_plots <- function(fit, param) {
  print(fit_summ[param,c(1,2,3,5,6,7,9,10)])
  print(stan_ac(fit, pars = param))
  print(rstan::traceplot(fit, pars = param))
}
get_aggreg_plots <- function(fit, param, trim = F, trim_amount) {
  ind <- grep(paste0("^",param), rownames(as.data.frame(summary(fit)$summary)))
  medians <- data.frame(avg = as.data.frame(summary(fit)$summary)$`50%`[ind])
  print(paste0("Summary statistics for posterior medians of ",param))
  print(summary(medians))
  title <- paste0("Posterior Medians of ",param)
  print(ggplot(medians, aes(x = avg)) + geom_histogram(bins = 60) + ggtitle(title))
  if (trim == T) {
    lim <- quantile(abs(medians$avg), probs = trim_amount)
    meds_trim <- medians %>% filter(abs(medians$avg) < lim)
    print(ggplot(meds_trim, aes(x = avg)) + geom_histogram(bins = 60) +
            ggtitle(paste0(title, " Without Extreme ",100*(1-trim_amount),"%")))
  }
}
plot_fit <- function(fit) {
  get_single_plots(fit, sigma_params)
#  get_single_plots(fit, beta_k)
  get_single_plots(fit, beta_0)
  get_single_plots(fit, other_1d)
  get_single_plots(fit, u)
  get_single_plots(fit, v)
  get_single_plots(fit, q)
  get_aggreg_plots(fit, "w")
  get_aggreg_plots(fit, "z")
  get_aggreg_plots(fit, "p")
  get_aggreg_plots(fit, "eta", trim = T, trim_amount = .60)
  get_aggreg_plots(fit, "lambda", trim = T, trim_amount = .60)
  get_aggreg_plots(fit, "kappa", trim = T, trim_amount = .60)
}
plot_fit(fit)
```

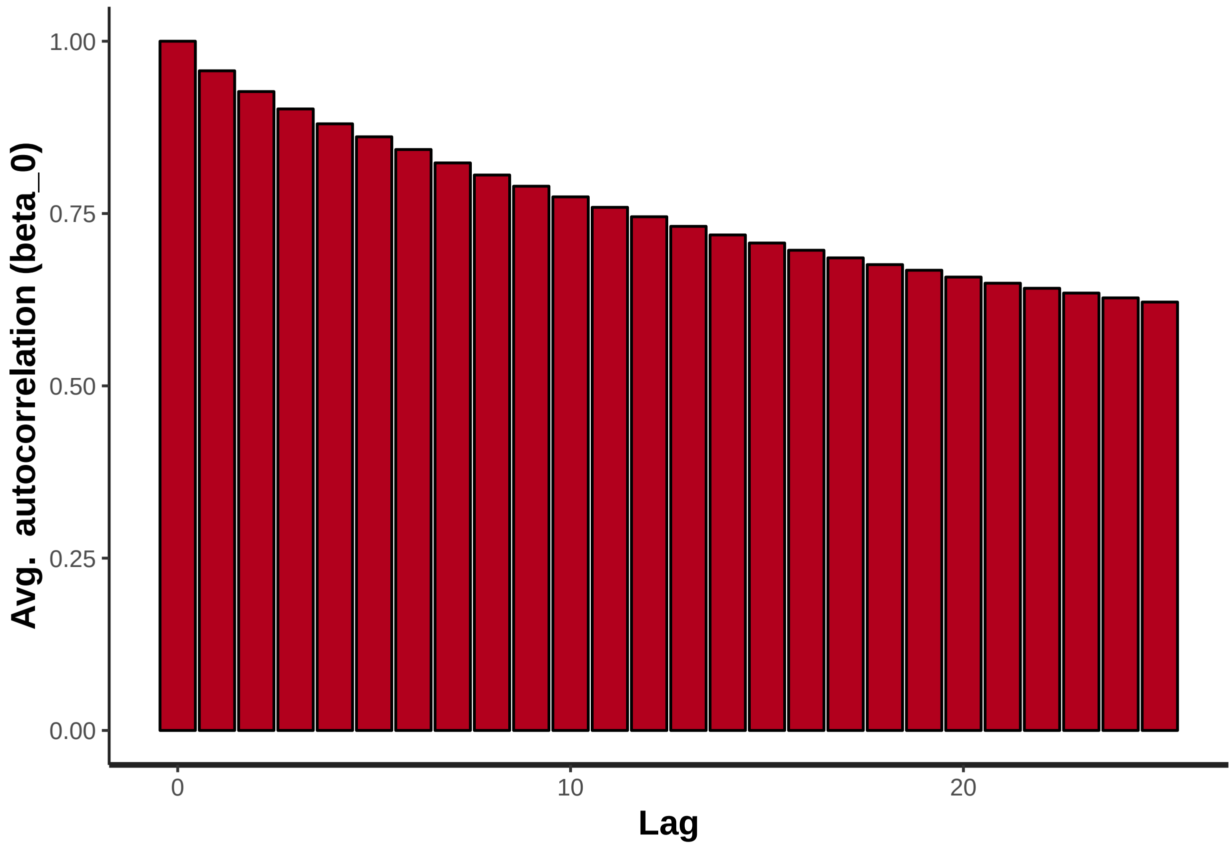
```
##                     mean      se_mean           sd       25%
## sigma_bk      18.5878733 4.530038e+00 4.079204e+01  4.5198615
## sigma_dbz      6.0440660 1.164386e-01 1.999330e+00  4.6701984
## sigma_k[1]     1.4216718 1.603498e-03 3.826438e-02  1.3953142
## sigma_k[2]     1.1883460 9.888942e-04 2.391510e-02  1.1719716
## sigma_k[3]     1.4018680 2.111458e-03 4.339573e-02  1.3718686
## sigma_k[4]     1.2481044 1.287275e-03 3.537291e-02  1.2241529
## sigma_k[5]     1.2836216 2.136197e-03 5.610150e-02  1.2446276
## sigma_k[6]     1.1120404 2.740307e-03 5.886624e-02  1.0706706
## sigma_k[7]     1.1605730 7.173782e-04 1.704060e-02  1.1485189
## sigma_uvq      0.8940711 1.063138e-02 1.828760e-01  0.7655714
## sigma_w        8.4270482 2.378429e-01 1.450506e+00  7.4197793
## sigma_w0       5.0433757 1.600353e-01 1.155340e+00  4.2578696
```

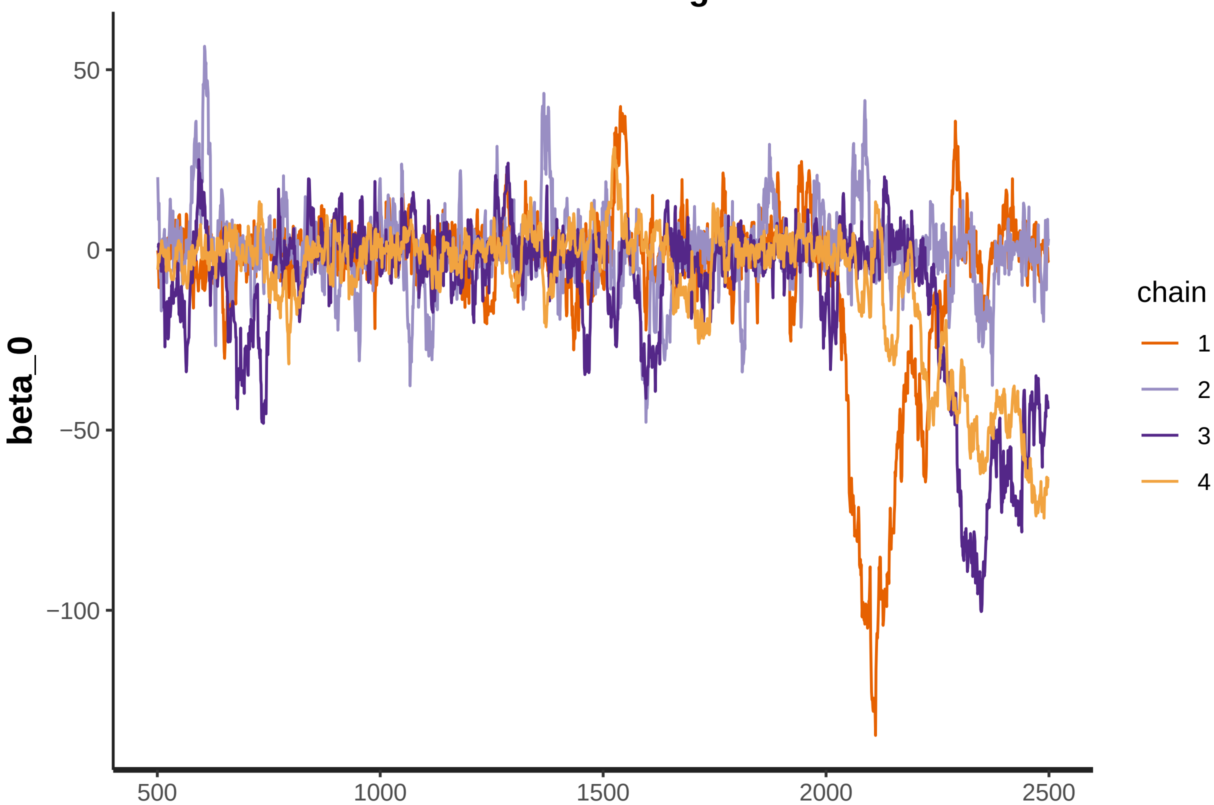
```
## sigmasq_bk      2009.2912793 1.029489e+03 1.944086e+04 20.4291484
## sigmasq_dbz       40.5275553 1.805545e+00 3.171518e+01 21.8107532
## sigmasq_i[1,1]     1.9671170 6.019993e-03 1.224060e-01  1.8820234
## sigmasq_i[1,2]     2.0226146 4.560068e-03 1.088780e-01  1.9469016
##                       50%          75%      n_eff      Rhat
## sigma_bk         7.7041121  16.1380344  81.08622 1.046016
## sigma_dbz        5.6245584   6.8906368 294.83239 1.022565
## sigma_k[1]       1.4212933   1.4483482 569.44584 1.005797
## sigma_k[2]       1.1882786   1.2037017 584.85046 1.017266
## sigma_k[3]       1.4006167   1.4281176 422.40518 1.015388
## sigma_k[4]       1.2472690   1.2715615 755.09004 1.008978
## sigma_k[5]       1.2813878   1.3195126 689.70989 1.004080
## sigma_k[6]       1.1095327   1.1505279 461.46005 1.001098
## sigma_k[7]       1.1603700   1.1719722 564.25233 1.006701
## sigma_uvq        0.8665829   0.9905461 295.89259 1.012904
## sigma_w          8.2599386   9.2542476  37.19278 1.117843
## sigma_w0         4.8442859   5.5796364  52.11801 1.059929
## sigmasq_bk      59.3533439 260.4361622 356.60493 1.011610
## sigmasq_dbz     31.6356568  47.4808762 308.54443 1.021207
## sigmasq_i[1,1]   1.9617273   2.0395199 413.44070 1.015816
## sigmasq_i[1,2]   2.0200746   2.0977126 570.08216 1.005662
```





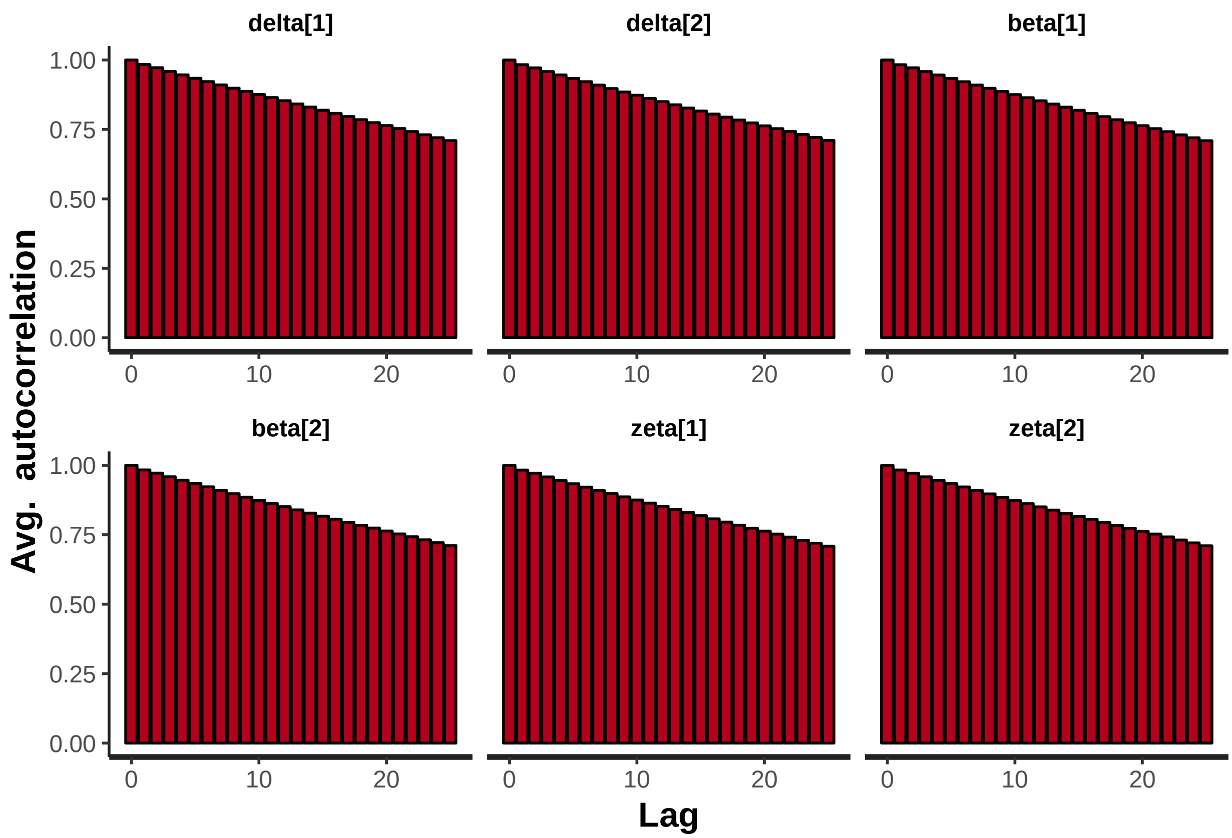

```
##              mean  se_mean       sd       25%       50%      75%    n_eff
## beta_0 -6.870809 3.010148 20.07358 -9.303653 -1.578251 2.778046 44.47072
##             Rhat
## beta_0 1.078061
```

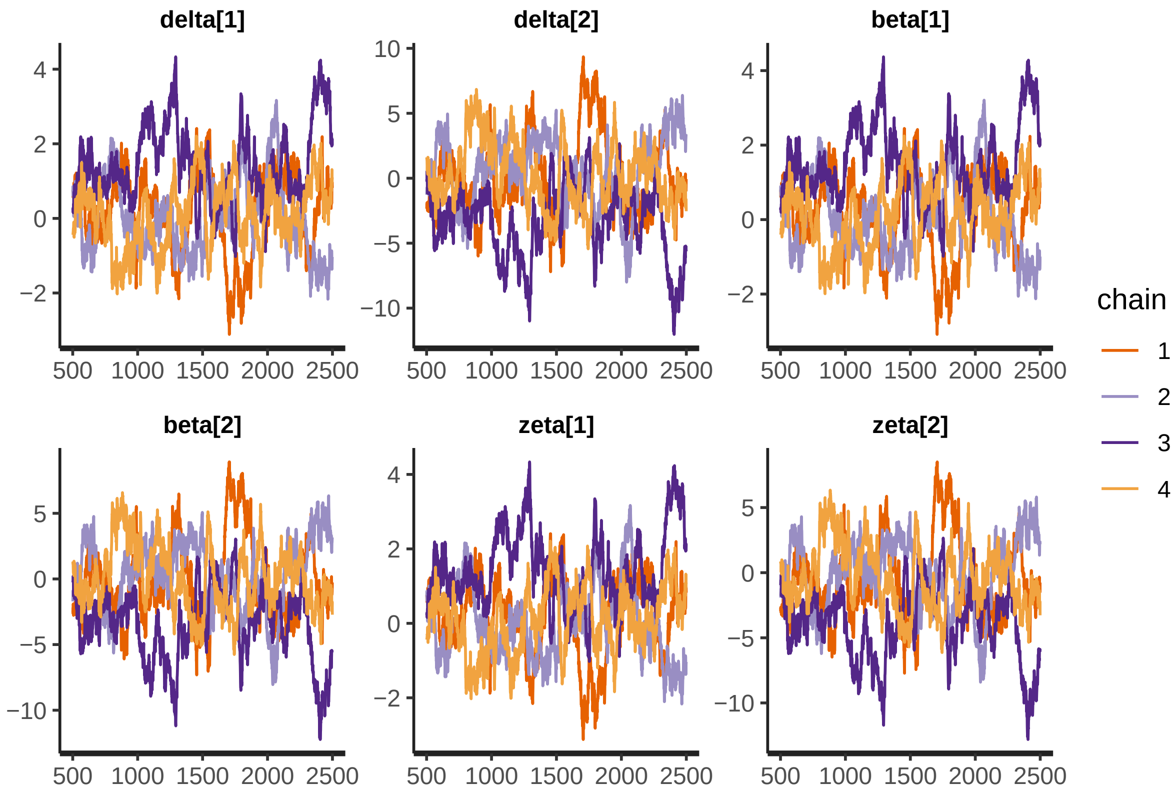




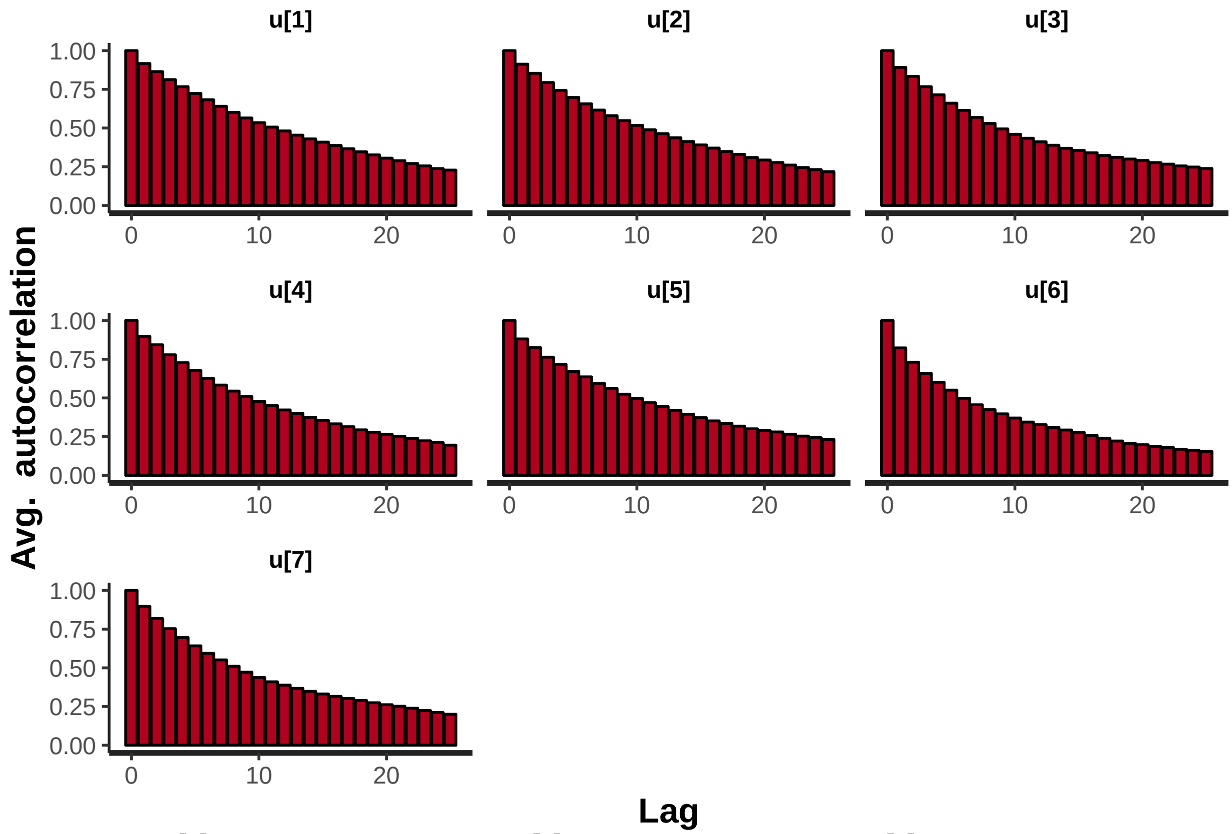

```
##                  mean   se_mean       sd        25%        50%       75%
## delta[1]  0.4247504 0.3659406 1.157296 -0.3332374  0.4038720 1.1322660
```

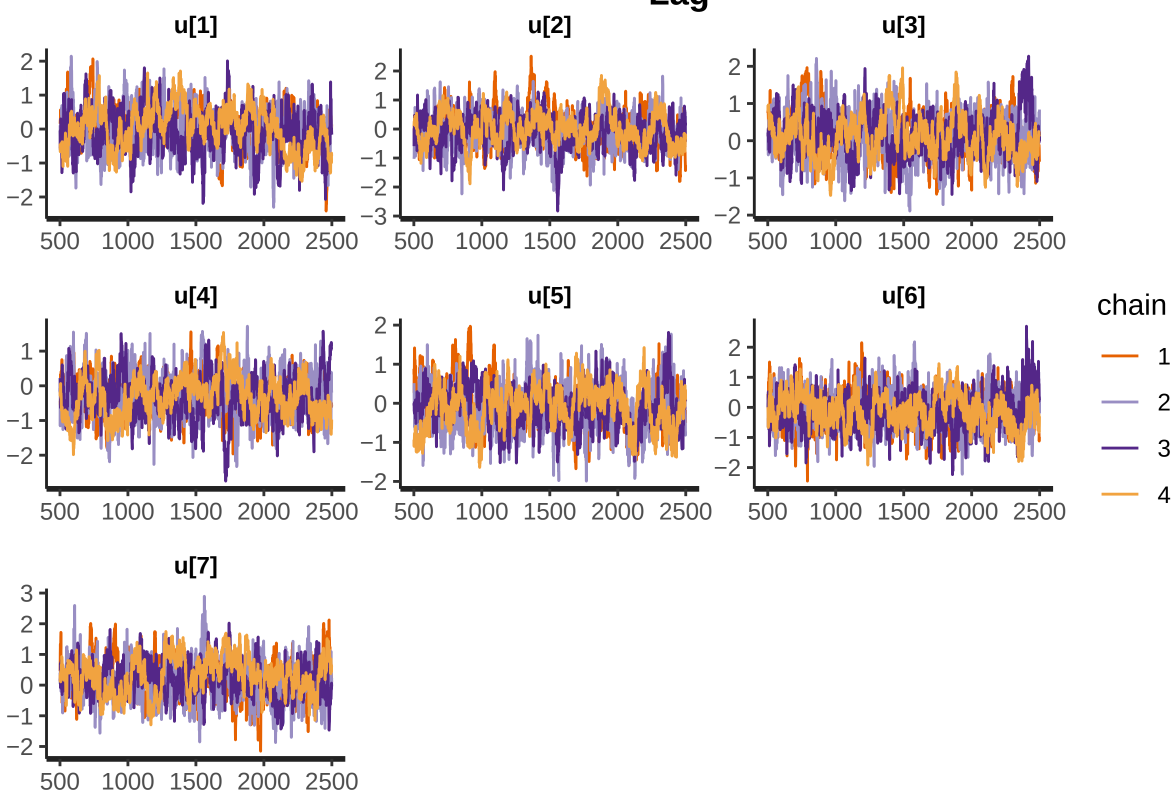
```
## delta[2] -0.6246253 0.9861628 3.157577 -2.5684005 -0.7170639 1.4139443
## beta[1]   0.4635942 0.3659646 1.157549 -0.2949686  0.4405504 1.1740899
## beta[2]  -0.8247760 0.9847337 3.155642 -2.7569394 -0.9267068 1.2060895
## zeta[1]   0.4272176 0.3659331 1.157703 -0.3322073  0.4065706 1.1394148
## zeta[2]  -1.2790750 0.9858921 3.156614 -3.2339959 -1.3780338 0.7599133
##             n_eff     Rhat
## delta[1] 10.00156 1.198297
## delta[2] 10.25205 1.191236
## beta[1]  10.00462 1.198195
## beta[2]  10.26923 1.191194
## zeta[1]  10.00901 1.198153
## zeta[2]  10.25142 1.191572
```





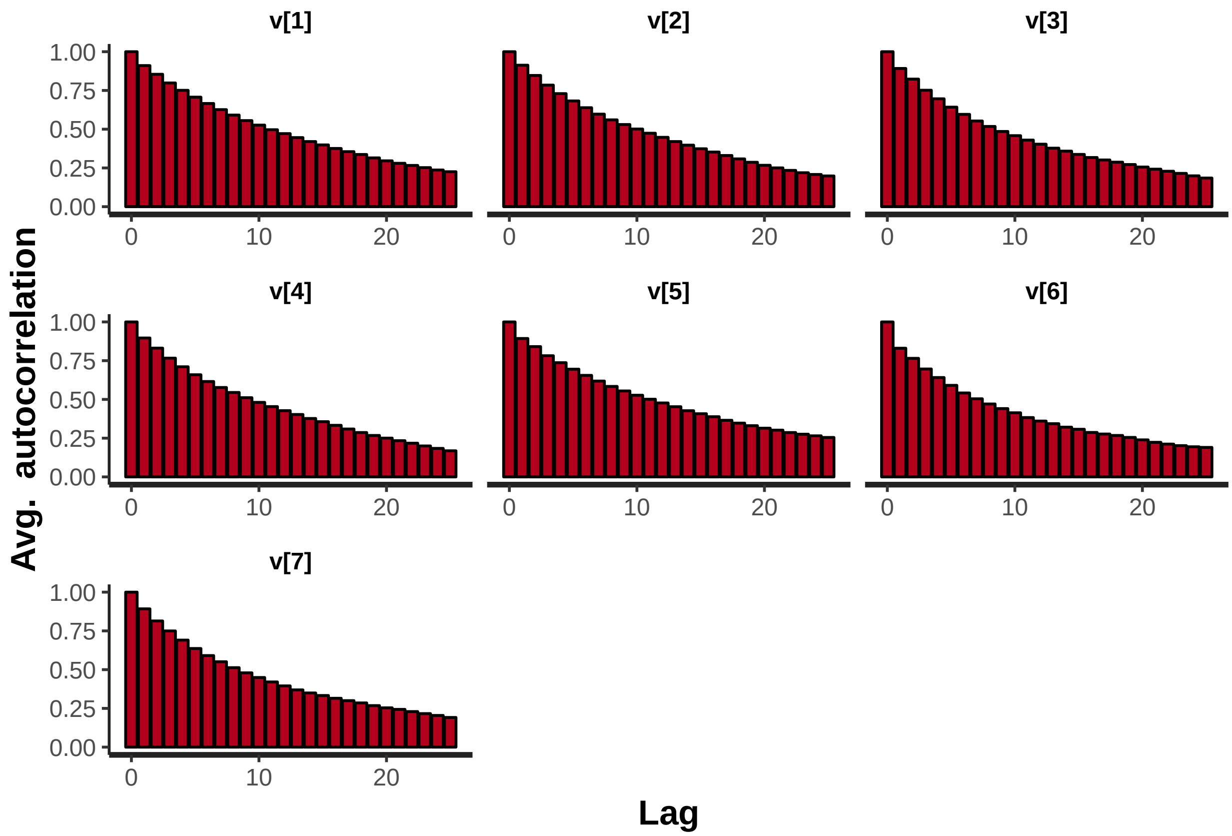

```
##            mean     se_mean        sd        25%         50%        75%
## u[1]  0.01542500 0.04545112 0.6199937 -0.3911291  0.04125187 0.43288500
## u[2] -0.05541200 0.03801795 0.5951867 -0.4449056 -0.06317242 0.33167249
## u[3]  0.14397962 0.03637159 0.5827792 -0.2373454  0.14441277 0.50854511
## u[4] -0.31698607 0.03611326 0.5921698 -0.7185925 -0.32488852 0.07167579
## u[5] -0.09013888 0.03877587 0.5593133 -0.4656329 -0.08664182 0.28264335
## u[6] -0.12048207 0.03266724 0.5962285 -0.5179279 -0.12056653 0.26783023
## u[7]  0.18806150 0.04714119 0.5971077 -0.2181753  0.16878087 0.57792615
##         n_eff     Rhat
## u[1] 186.0738 1.032229
## u[2] 245.0920 1.016509
## u[3] 256.7341 1.008974
## u[4] 268.8804 1.006815
## u[5] 208.0594 1.028187
## u[6] 333.1200 1.005210
## u[7] 160.4369 1.028979
```

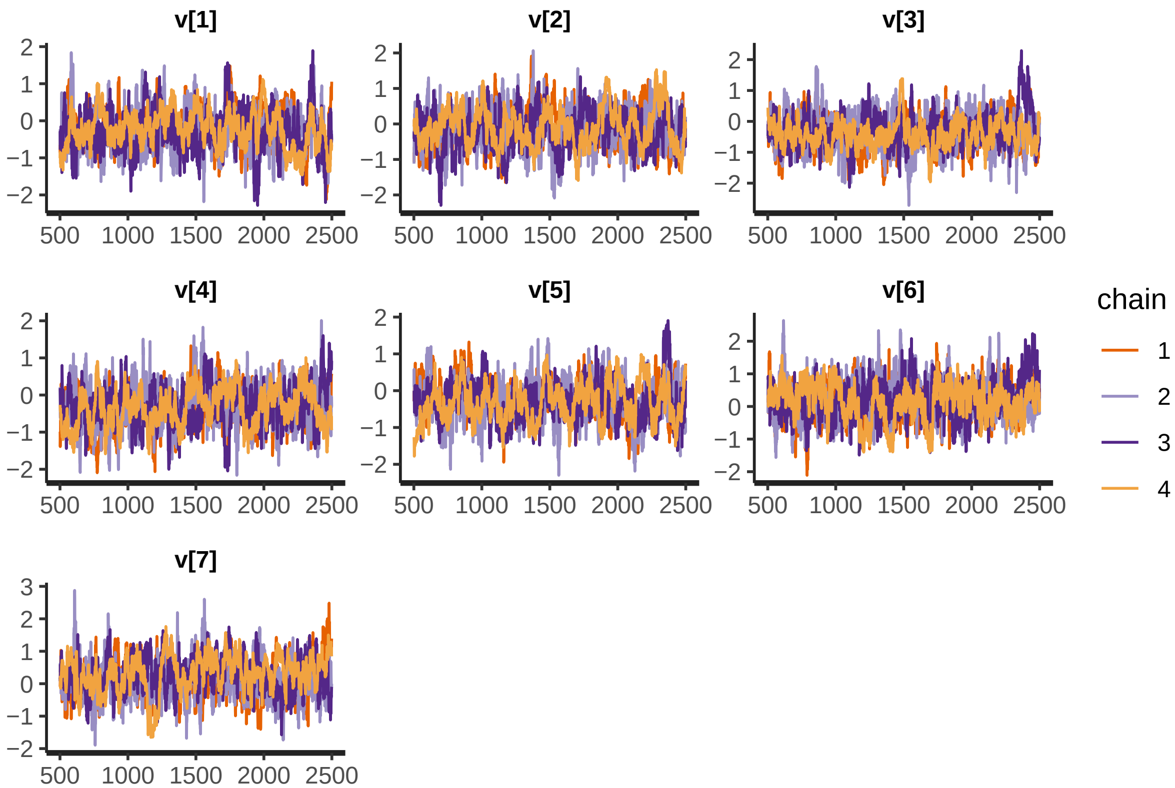




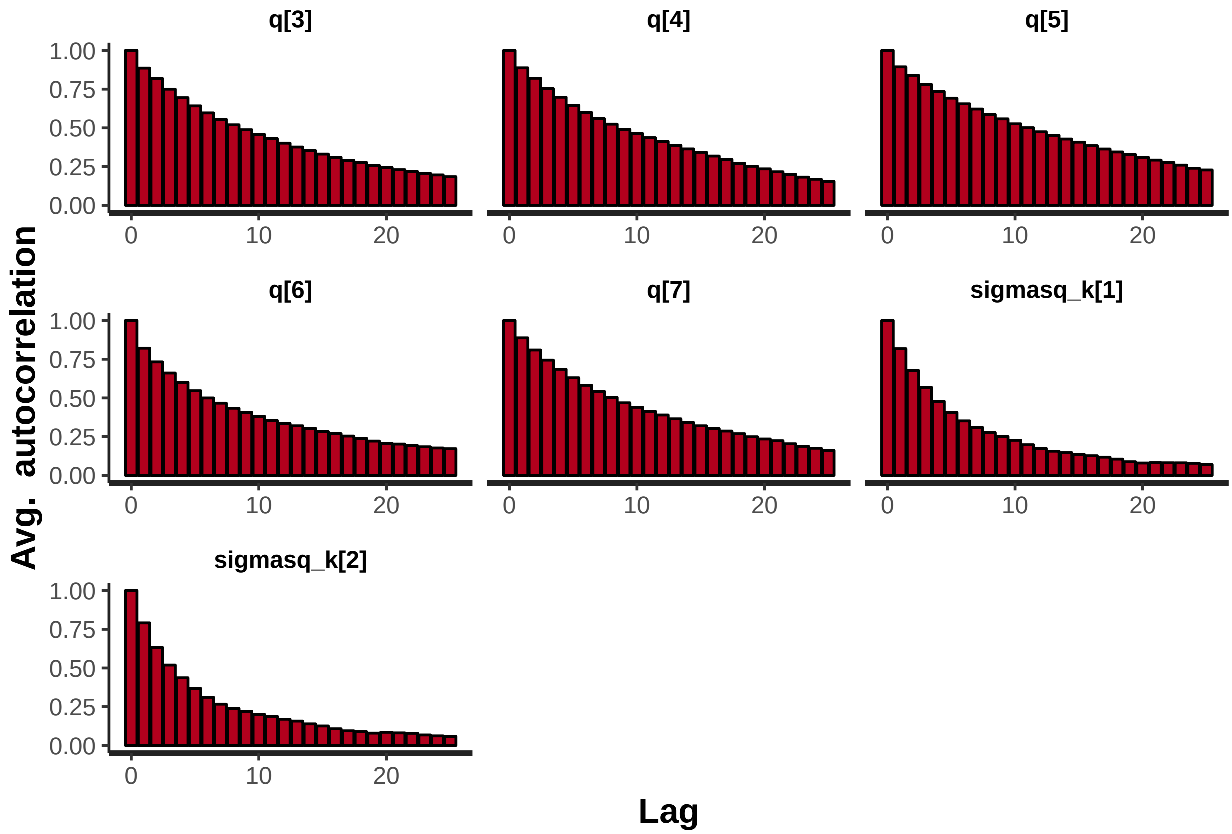

```
##              mean     se_mean        sd        25%        50%         75%
## v[1] -0.2488353 0.03277316 0.5416568 -0.6002155 -0.2515273  0.10014229
## v[2] -0.1368677 0.03490105 0.5469623 -0.5116391 -0.1408687  0.22873488
```

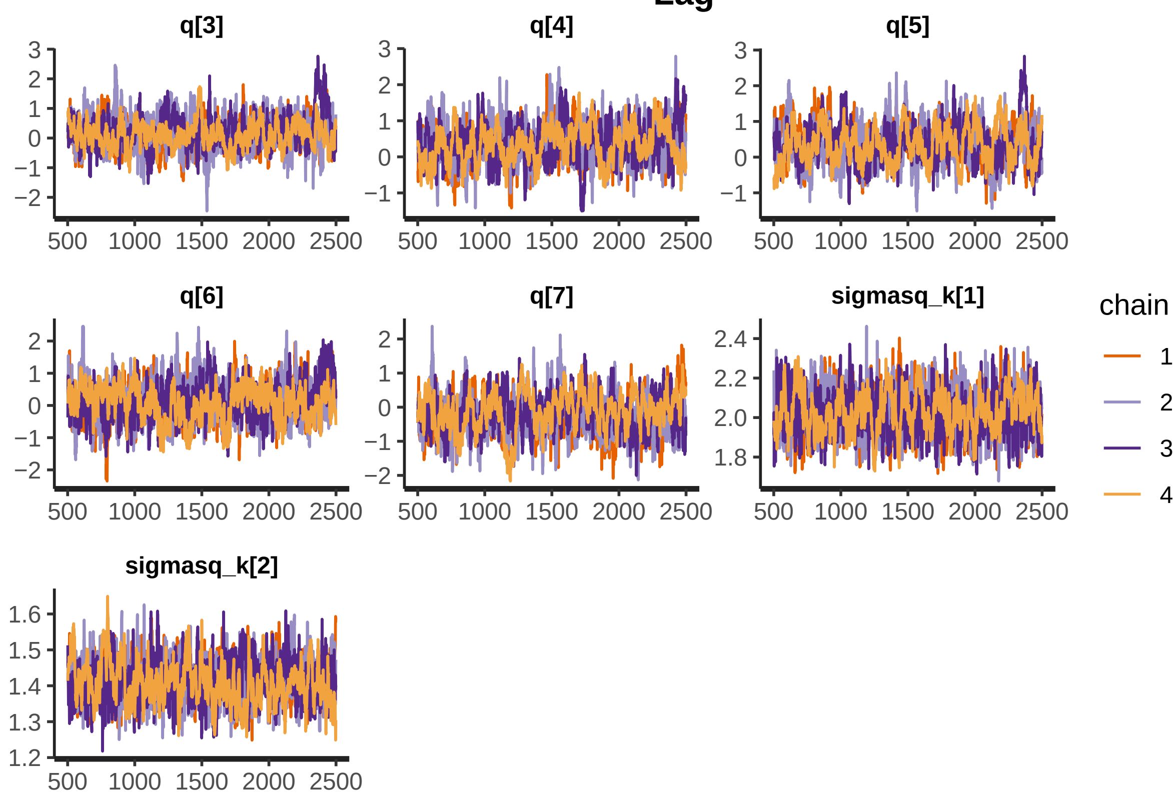
```
## v[3] -0.3539072 0.03246315 0.5339264 -0.6970466 -0.3600772 -0.03089573
## v[4] -0.3176923 0.03228292 0.5372821 -0.6744672 -0.3065160  0.03772887
## v[5] -0.2850039 0.03346607 0.5326037 -0.6436970 -0.2901775  0.05523375
## v[6]  0.1830443 0.04020870 0.5666695 -0.1798653  0.1801372  0.54853434
## v[7]  0.2028384 0.03751267 0.5677271 -0.1699015  0.1853912  0.58442767
##         n_eff     Rhat
## v[1] 273.1566 1.007833
## v[2] 245.6053 1.002977
## v[3] 270.5088 1.014482
## v[4] 276.9868 1.019109
## v[5] 253.2789 1.007429
## v[6] 198.6184 1.012979
## v[7] 229.0464 1.024672
```





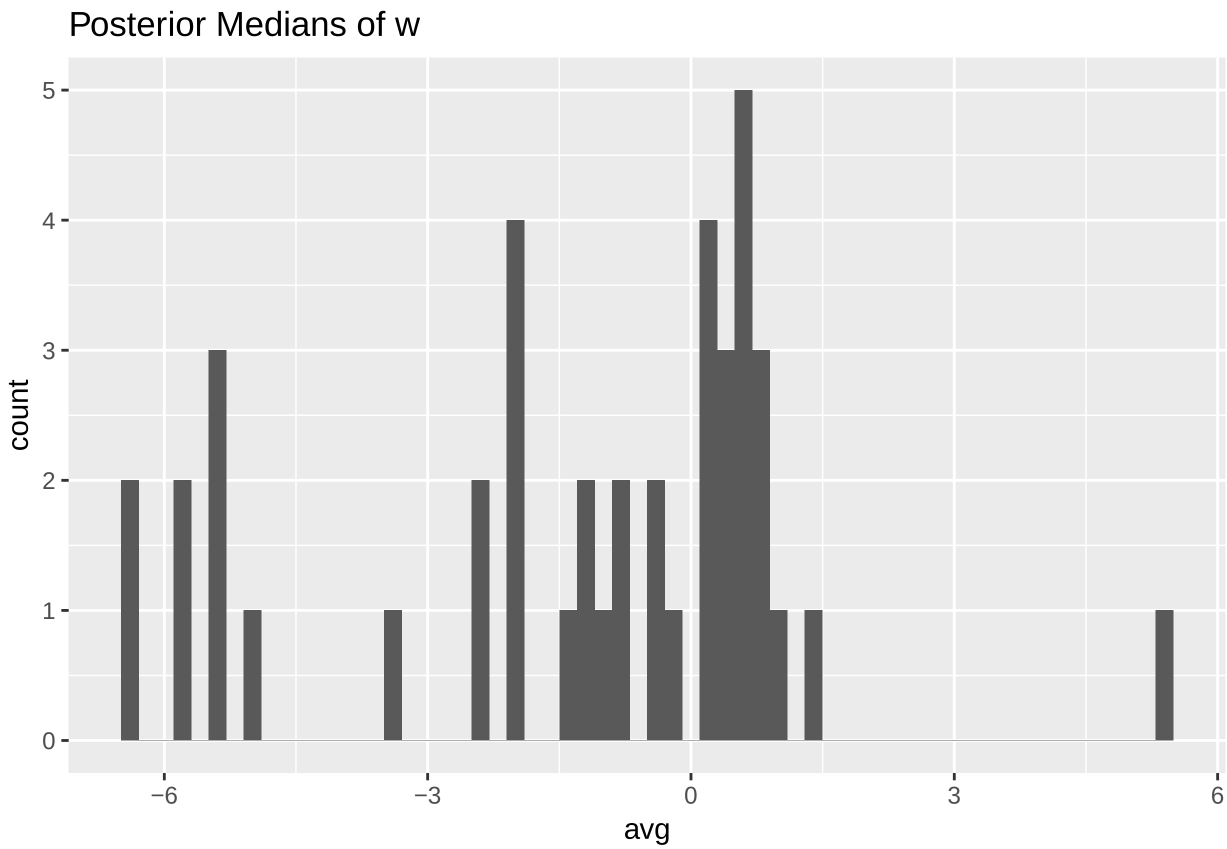

```
##                       mean     se_mean         sd          25%        50%
## q[3]            0.1799219 0.032485599 0.53323475 -0.161698612  0.1691672
## q[4]            0.3743665 0.030890560 0.53050173  0.024860205  0.3758419
## q[5]            0.3742565 0.032602561 0.53089130  0.007433851  0.3677889
## q[6]            0.1105945 0.040688707 0.57583829 -0.270384726  0.1024237
## q[7]           -0.2212188 0.035685348 0.57188562 -0.608359661 -0.2475617
## sigmasq_k[1]    2.0226146 0.004560068 0.10887798  1.946901639  2.0200746
## sigmasq_k[2]    1.4127380 0.002354506 0.05691843  1.373517341  1.4120061
##                      75%    n_eff     Rhat
## q[3]           0.5099499 269.4357 1.015877
## q[4]           0.7198297 294.9321 1.017368
## q[5]           0.7065019 265.1599 1.006439
## q[6]           0.4761384 200.2872 1.013465
## q[7]           0.1639954 256.8257 1.021457
## sigmasq_k[1] 2.0977126 570.0822 1.005662
## sigmasq_k[2] 1.4488978 584.3946 1.017202
```



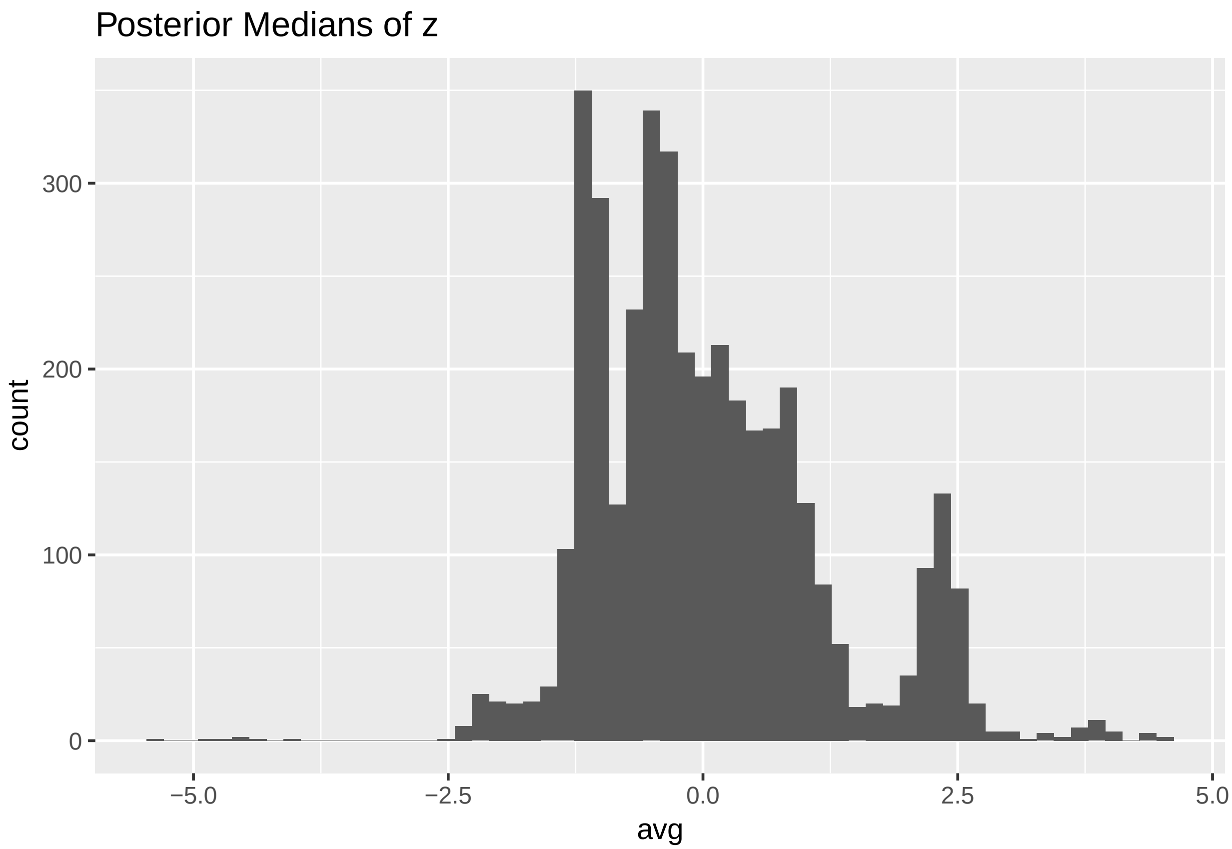



```
## [1] "Summary statistics for posterior medians of w"
##       avg
##  Min.   :-6.4765
```

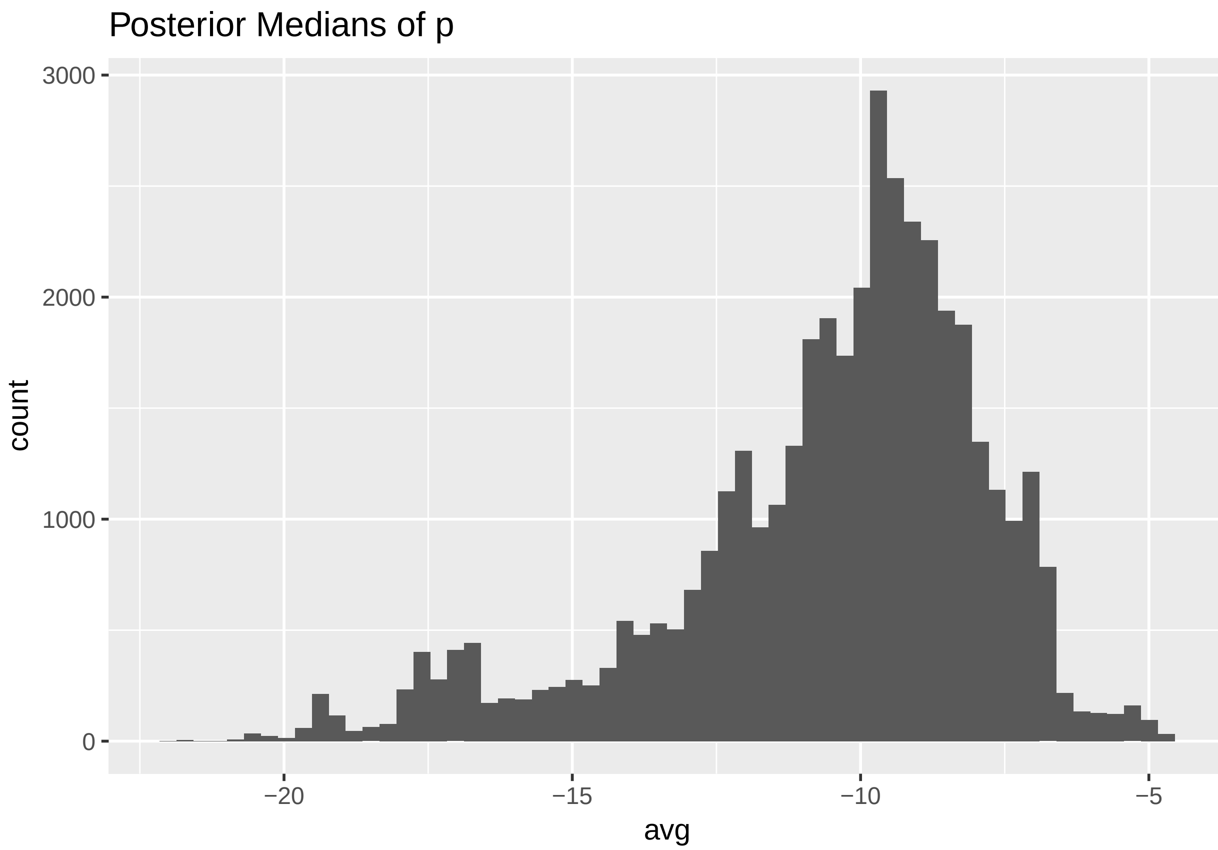
```
##  1st Qu.:-2.2648
##  Median :-0.5966
##  Mean   :-1.2911
##  3rd Qu.: 0.5073
##  Max.   : 5.3059
```



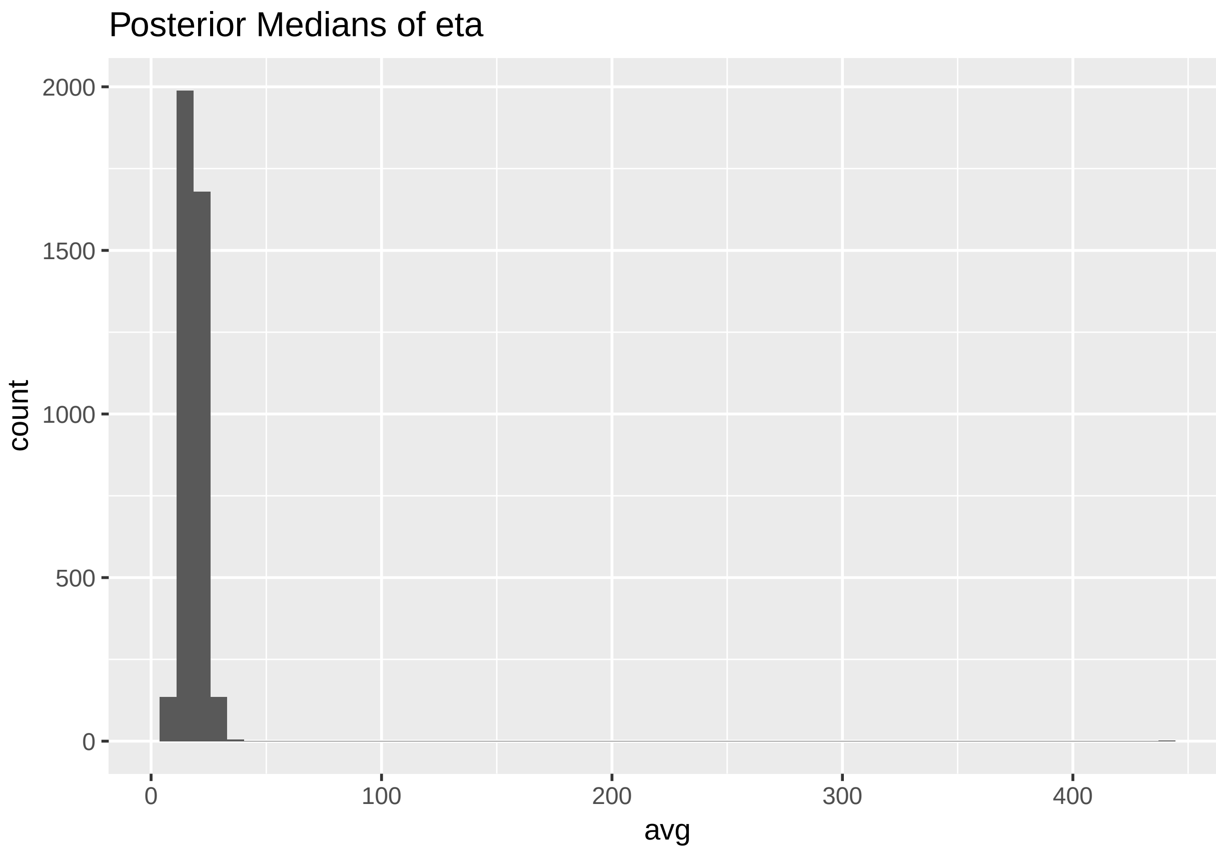

```
## [1] "Summary statistics for posterior medians of z"
##       avg
##  Min.   :-5.32316
##  1st Qu.:-0.77226
##  Median :-0.20064
##  Mean   : 0.04484
##  3rd Qu.: 0.69798
##  Max.   : 4.58686
```

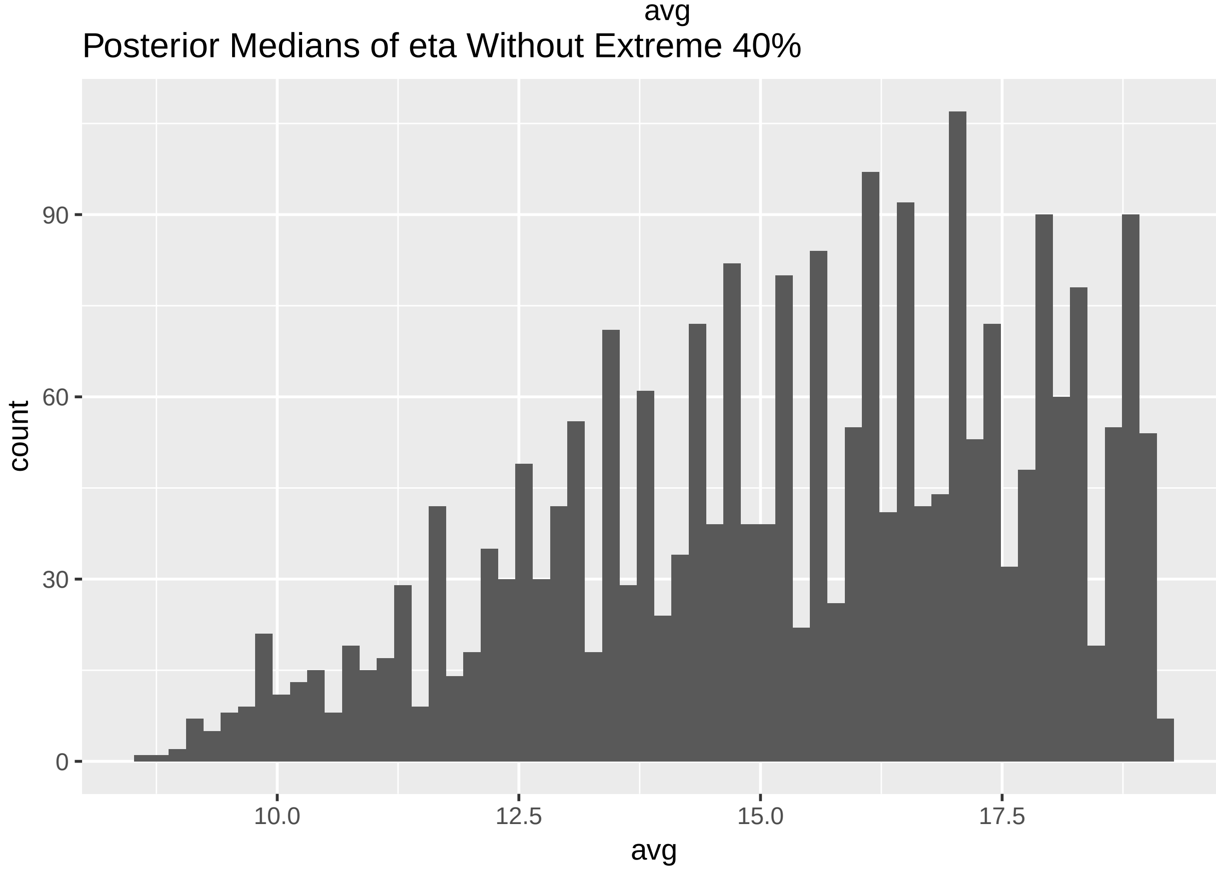



```
## [1] "Summary statistics for posterior medians of p"
##       avg
##  Min.   :-21.893
##  1st Qu.:-11.883
##  Median : -9.890
##  Mean   :-10.535
##  3rd Qu.: -8.681
##  Max.   : -4.576
```

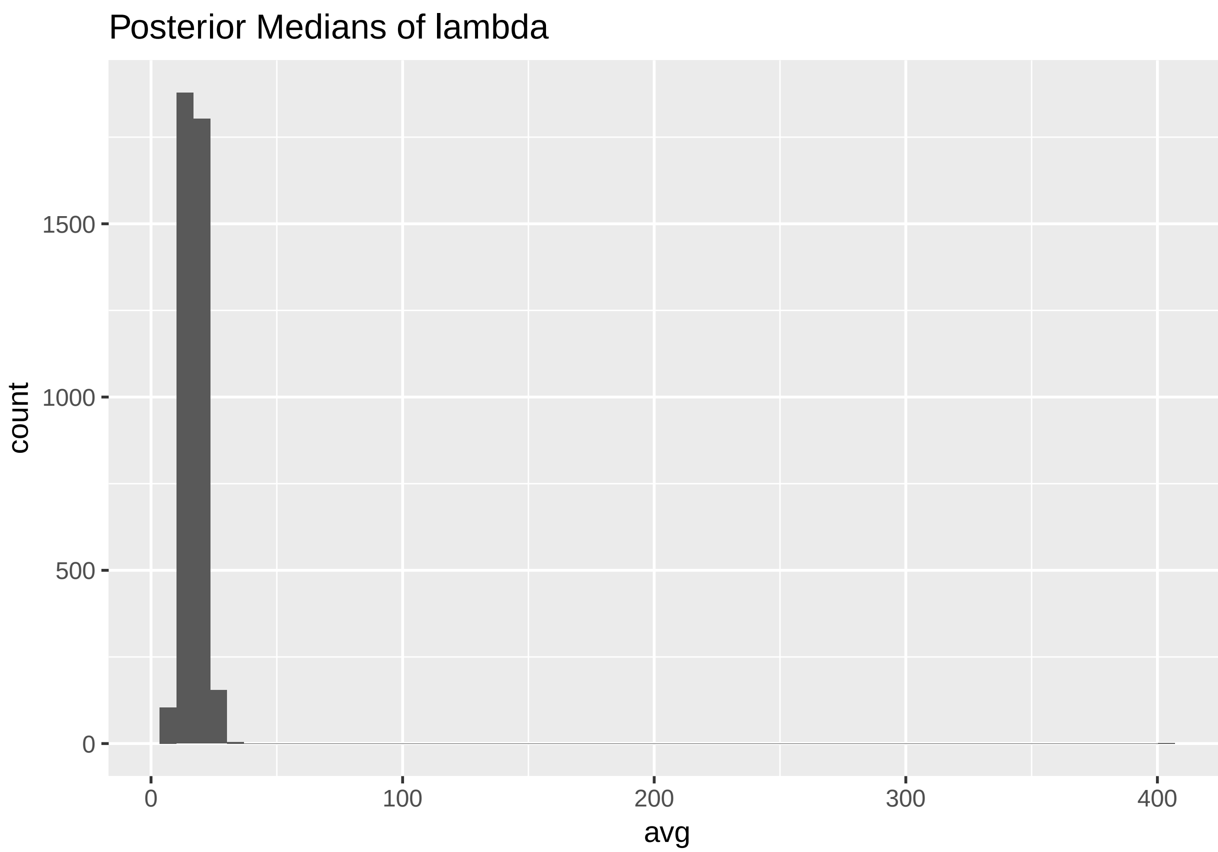


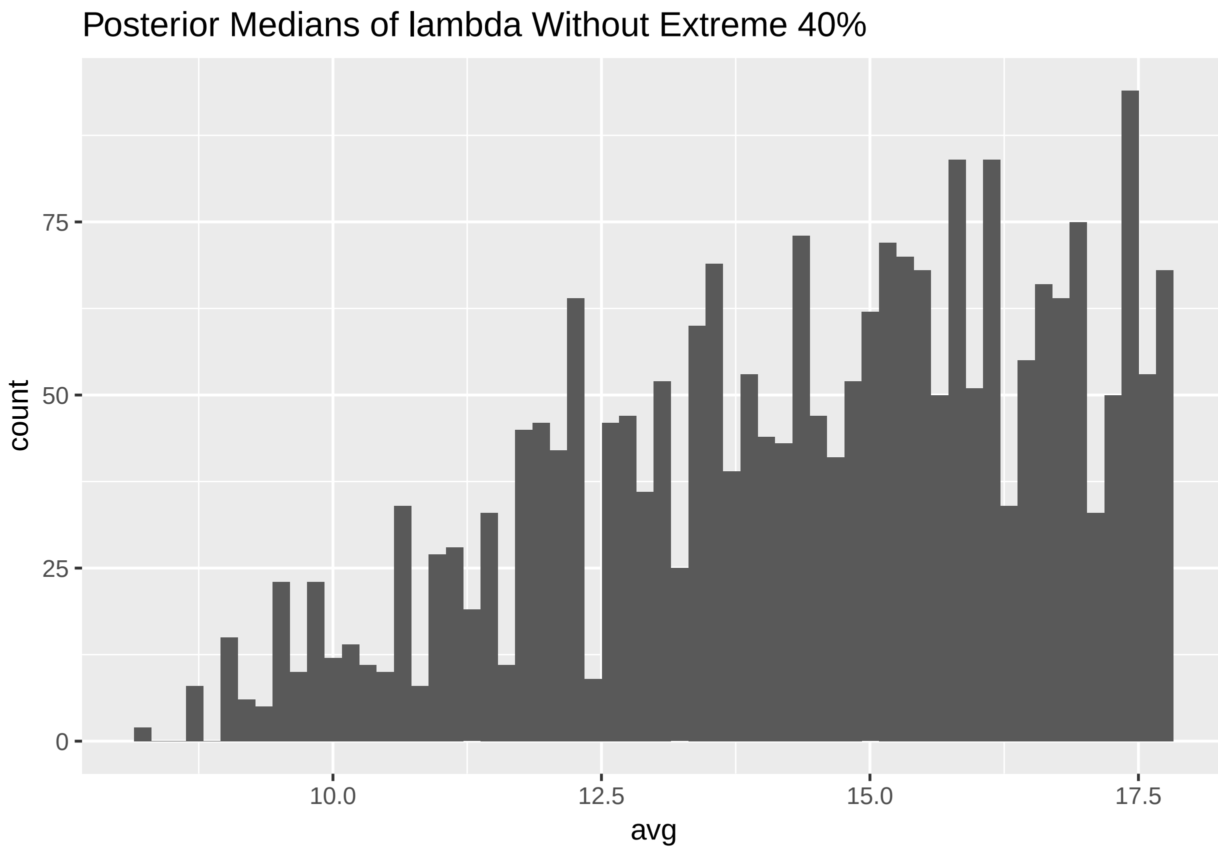

```
## [1] "Summary statistics for posterior medians of eta"
##       avg
##  Min.   :  8.579
##  1st Qu.: 15.026
##  Median : 17.891
##  Mean   : 18.312
##  3rd Qu.: 20.966
##  Max.   :442.019
```


Posterior Medians of eta
count
2000
1500
1000
500
0
0
100
200
300
400
avg

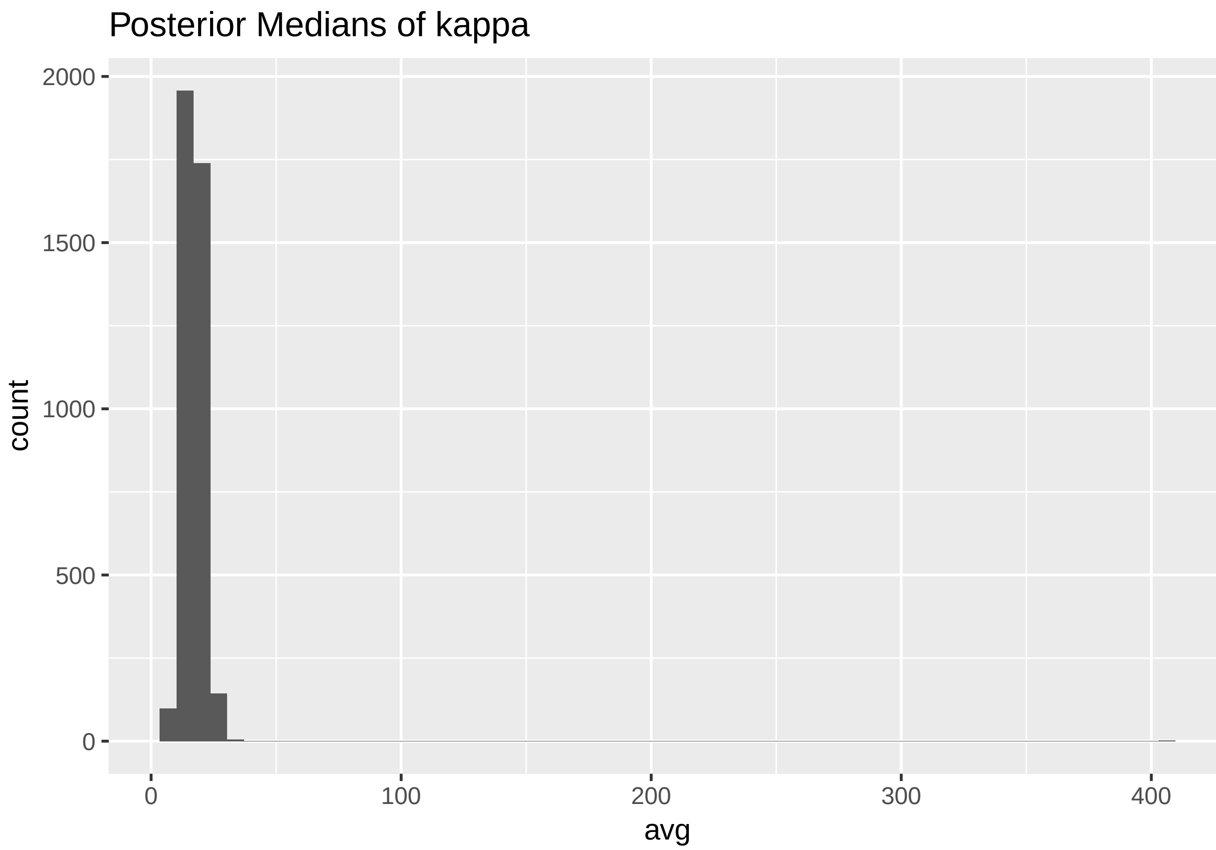

Posterior Medians of eta Without Extreme 40%
count
90
60
30
0
10.0
12.5
15.0
17.5
avg

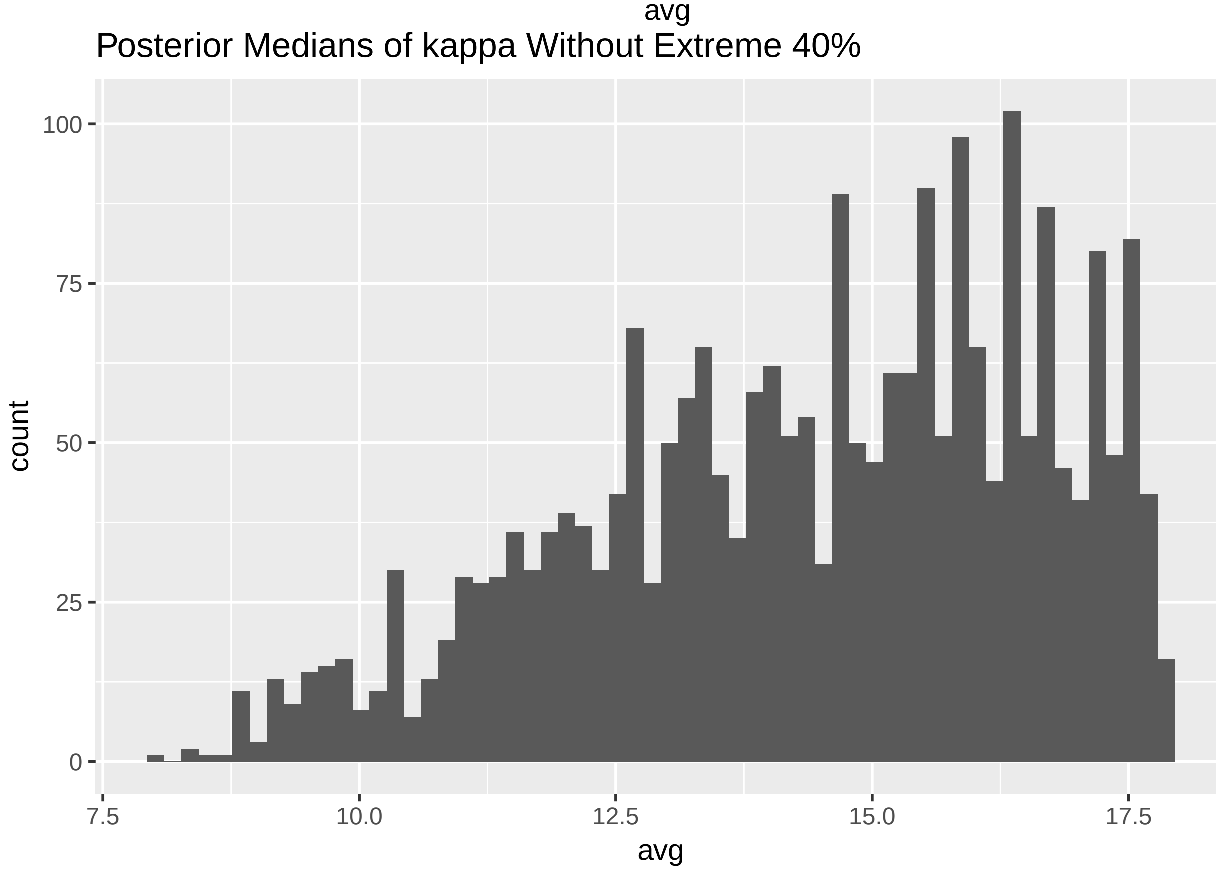
```
## [1] "Summary statistics for posterior medians of lambda"
##       avg
##  Min.   :  8.29
##  1st Qu.: 14.12
##  Median : 16.80
##  Mean   : 17.13
##  3rd Qu.: 19.51
##  Max.   :405.14
```






```
## [1] "Summary statistics for posterior medians of kappa"
##       avg
##  Min.   :  7.992
##  1st Qu.: 14.199
##  Median : 16.751
##  Mean   : 17.111
##  3rd Qu.: 19.487
##  Max.   :407.443
```


Posterior Medians of kappa
2000
1500
1000
500
0
count
0
100
200
300
400
avg


Posterior Medians of kappa Without Extreme 40%
100
75
50
25
0
count
7.5
10.0
12.5
15.0
17.5
avg

Identifying Parameters with Large Rhats

```r
summary(fit_summ$Rhat)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.001   1.069   1.077   1.098   1.090   5.803
```

```r
big_Rhat <- fit_summ$Rhat > 5
big_Rhat_dat <- fit_summ[big_Rhat,c(1,2,10)]
big_Rhat_dat
```

```
##                mean  se_mean     Rhat
## w[4,1,1] -0.9690889 2.891008 5.803437
```