ps7 solutions

Question 2

prelims

```
rm(list=ls())
set.seed(123)
library(rstan)
```

```
## Loading required package: StanHeaders
```

```
##
## rstan version 2.32.5 (Stan version 2.32.2)
```

```
## For execution on a local, multicore CPU with excess RAM we recommend calling
## options(mc.cores = parallel::detectCores()).
## To avoid recompilation of unchanged Stan programs, we recommend calling
## rstan_options(auto_write = TRUE)
## For within-chain threading using `reduce_sum()` or `map_rect()` Stan functions,
## change `threads_per_chain` option:
## rstan_options(threads_per_chain = 1)
```

```
options(mc.cores = parallel::detectCores())

data = read.csv("MetabolicRate.csv")
log_size = log(data$BodySize)
log_rate = log(data$Mrate)
instar = data$Instar
N = length(instar)
```

Step 2

```
fit = stan("ps_7.stan", iter = 10000, chains = 4,
         data = list(N = N, log_rate = log_rate, log_size = log_size, instar = instar))
```

```
## Trying to compile a simple C file
```

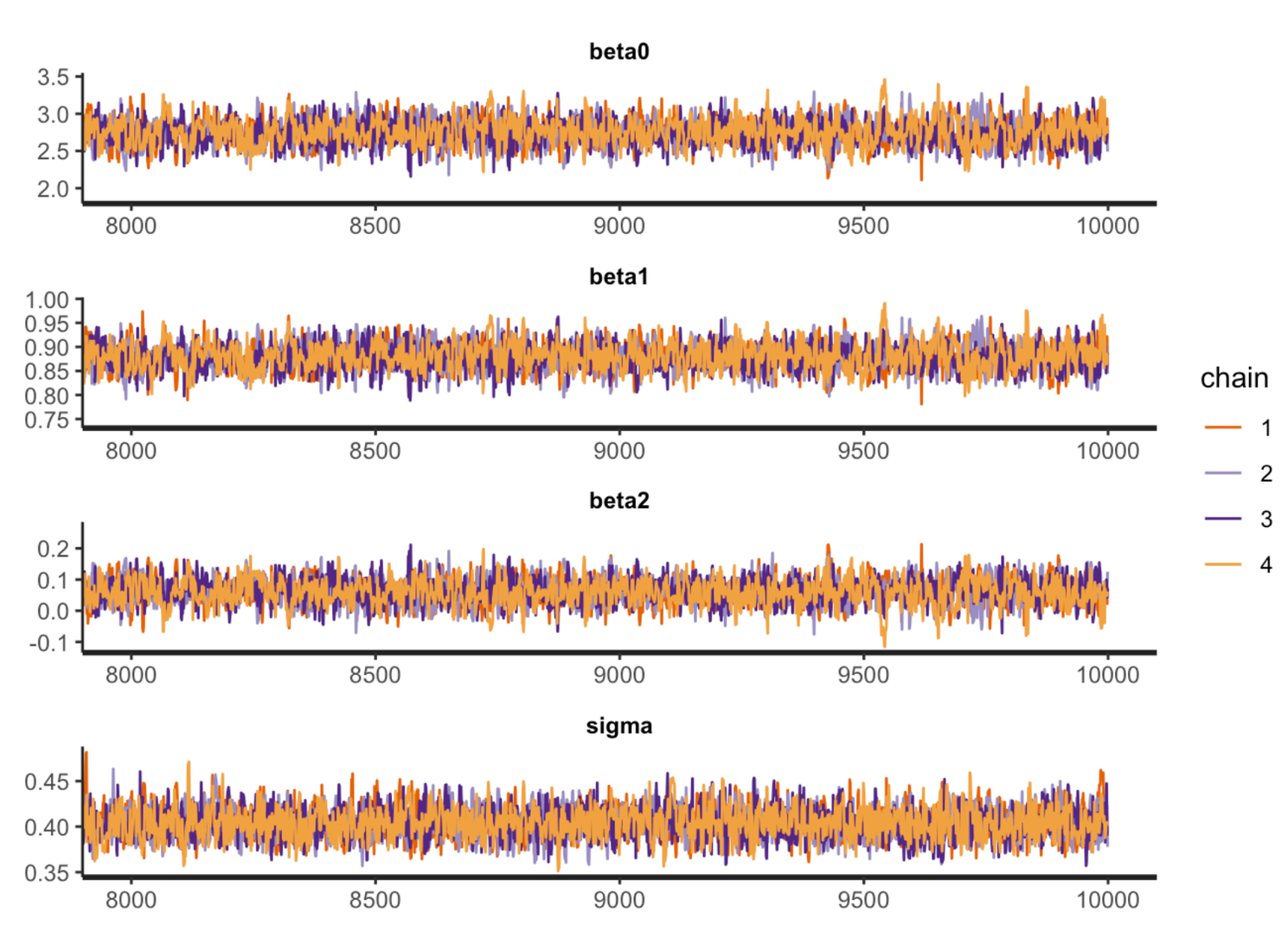
```
## Running /Library/Frameworks/R.framework/Resources/bin/R CMD SHLIB foo.c
## using C compiler: ‘Apple clang version 14.0.0 (clang-1400.0.29.202)’
## using SDK: ‘MacOSX13.1.sdk’
## clang -arch arm64 -I"/Library/Frameworks/R.framework/Resources/include" -DNDEBUG   -I"/Library/Frameworks/R.fr
amework/Versions/4.3-arm64/Resources/library/Rcpp/include/"  -I"/Library/Frameworks/R.framework/Versions/4.3-arm6
4/Resources/library/RcppEigen/include/"  -I"/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/
RcppEigen/include/unsupported"  -I"/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/BH/includ
e" -I"/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/StanHeaders/include/src/"  -I"/Librar
y/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/StanHeaders/include/"  -I"/Library/Frameworks/R.fra
mework/Versions/4.3-arm64/Resources/library/RcppParallel/include/"  -I"/Library/Frameworks/R.framework/Versions/
4.3-arm64/Resources/library/rstan/include" -DEIGEN_NO_DEBUG  -DBOOST_DISABLE_ASSERTS  -DBOOST_PENDING_INTEGER_LOG
2_HPP  -DSTAN_THREADS  -DUSE_STANC3 -DSTRICT_R_HEADERS  -DBOOST_PHOENIX_NO_VARIADIC_EXPRESSION  -D_HAS_AUTO_PTR_E
TC=0  -include '/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/StanHeaders/include/stan/mat
h/prim/fun/Eigen.hpp'  -D_REENTRANT -DRCPP_PARALLEL_USE_TBB=1  -I/opt/R/arm64/include    -fPIC  -falign-function
s=64 -Wall -g -O2  -c foo.c -o foo.o
## In file included from <built-in>:1:
## In file included from /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/StanHeaders/includ
e/stan/math/prim/fun/Eigen.hpp:22:
## In file included from /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/RcppEigen/include/E
igen/Dense:1:
## In file included from /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/RcppEigen/include/E
igen/Core:88:
## /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/RcppEigen/include/Eigen/src/Core/util/Mac
ros.h:628:1: error: unknown type name 'namespace'
## namespace Eigen {
## ^
## /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/RcppEigen/include/Eigen/src/Core/util/Mac
ros.h:628:16: error: expected ';' after top level declarator
## namespace Eigen {
##                ^
##                ;
## In file included from <built-in>:1:
## In file included from /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/StanHeaders/includ
e/stan/math/prim/fun/Eigen.hpp:22:
## In file included from /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/RcppEigen/include/E
igen/Dense:1:
## /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library/RcppEigen/include/Eigen/Core:96:10: fatal
error: 'complex' file not found
## #include <complex>
##          ^~~~~~~~~
## 3 errors generated.
## make: *** [foo.o] Error 1
```

```
print(fit, probs = c(0.25, 0.5, 0.75))
```

```
## Inference for Stan model: anon_model.
## 4 chains, each with iter=10000; warmup=5000; thin=1;
## post-warmup draws per chain=5000, total post-warmup draws=20000.
##
##              mean se_mean   sd    25%    50%    75% n_eff Rhat
## beta0        2.75    0.00 0.18   2.63   2.75   2.87  4371    1
## beta1        0.88    0.00 0.03   0.86   0.88   0.90  4531    1
## beta2        0.06    0.00 0.04   0.03   0.06   0.09  4472    1
## sigma        0.40    0.00 0.02   0.39   0.40   0.41  7360    1
## yPred[1]    -2.61    0.00 0.06  -2.66  -2.61  -2.57 10967    1
## yPred[2]    -1.27    0.00 0.05  -1.31  -1.28  -1.24 16914    1
## yPred[3]    -1.69    0.00 0.05  -1.72  -1.69  -1.65 19277    1
## yPred[4]    -1.70    0.00 0.05  -1.74  -1.70  -1.67 19248    1
## yPred[5]    -1.67    0.00 0.05  -1.71  -1.67  -1.64 19297    1
## yPred[6]    -1.48    0.00 0.05  -1.51  -1.48  -1.45 18807    1
## yPred[7]    -0.68    0.00 0.05  -0.71  -0.68  -0.64  9065    1
## yPred[8]    -0.85    0.00 0.05  -0.88  -0.85  -0.81 10649    1
## yPred[9]    -1.06    0.00 0.05  -1.09  -1.06  -1.02 13410    1
## yPred[10]   -0.93    0.00 0.05  -0.96  -0.93  -0.90 11604    1
## yPred[11]   -1.35    0.00 0.05  -1.38  -1.35  -1.32 17741    1
## yPred[12]   -1.50    0.00 0.05  -1.54  -1.50  -1.47 18942    1
## yPred[13]   -1.27    0.00 0.05  -1.31  -1.28  -1.24 16914    1
## yPred[14]   -1.55    0.00 0.05  -1.58  -1.55  -1.52 19159    1
## yPred[15]   -0.73    0.00 0.05  -0.76  -0.73  -0.69  9467    1
## yPred[16]   -0.73    0.00 0.05  -0.76  -0.73  -0.69  9467    1
## yPred[17]   -1.76    0.00 0.05  -1.80  -1.77  -1.73 19048    1
## yPred[18]   -0.57    0.00 0.05  -0.61  -0.57  -0.53  8259    1
## yPred[19]   -1.76    0.00 0.05  -1.80  -1.77  -1.73 19048    1
## yPred[20]   -0.57    0.00 0.05  -0.61  -0.57  -0.53  8259    1
## yPred[21]   -1.52    0.00 0.05  -1.55  -1.52  -1.48 19004    1
## yPred[22]   -0.26    0.00 0.06  -0.30  -0.26  -0.23  6703    1
## yPred[23]   -1.52    0.00 0.05  -1.55  -1.52  -1.48 19004    1
## yPred[24]   -0.26    0.00 0.06  -0.30  -0.26  -0.23  6703    1
## yPred[25]   -1.78    0.00 0.05  -1.81  -1.78  -1.75 18977    1
## yPred[26]   -0.46    0.00 0.05  -0.50  -0.46  -0.43  7603    1
## yPred[27]   -0.17    0.00 0.06  -0.20  -0.17  -0.13  6363    1
## yPred[28]   -1.78    0.00 0.05  -1.81  -1.78  -1.75 18977    1
## yPred[29]   -0.46    0.00 0.05  -0.50  -0.46  -0.43  7603    1
## yPred[30]   -0.75    0.00 0.04  -0.77  -0.75  -0.72 12829    1
## yPred[31]   -0.35    0.00 0.03  -0.37  -0.35  -0.32 20003    1
## yPred[32]   -0.13    0.00 0.03  -0.15  -0.13  -0.11 20250    1
## yPred[33]   -0.35    0.00 0.03  -0.37  -0.35  -0.33 19968    1
## yPred[34]   -0.34    0.00 0.03  -0.36  -0.34  -0.31 20104    1
## yPred[35]   -0.13    0.00 0.03  -0.15  -0.13  -0.11 20225    1
## yPred[36]   -0.86    0.00 0.04  -0.88  -0.86  -0.83 11427    1
## yPred[37]   -0.14    0.00 0.03  -0.16  -0.14  -0.12 20321    1
## yPred[38]   -0.62    0.00 0.04  -0.64  -0.62  -0.59 15011    1
## yPred[39]   -0.05    0.00 0.03  -0.07  -0.05  -0.03 19260    1
## yPred[40]   -0.07    0.00 0.03  -0.09  -0.07  -0.05 19552    1
## yPred[41]    0.11    0.00 0.03   0.09   0.11   0.13 15397    1
## yPred[42]    0.75    0.00 0.04   0.72   0.75   0.78  6731    1
## yPred[43]   -0.21    0.00 0.03  -0.23  -0.21  -0.19 20675    1
## yPred[44]   -0.40    0.00 0.03  -0.42  -0.40  -0.37 19431    1
## yPred[45]   -0.24    0.00 0.03  -0.26  -0.24  -0.22 20668    1
## yPred[46]   -0.16    0.00 0.03  -0.18  -0.16  -0.14 20499    1
## yPred[47]   -0.36    0.00 0.03  -0.38  -0.36  -0.33 19894    1
## yPred[48]   -0.63    0.00 0.04  -0.65  -0.63  -0.60 14827    1
## yPred[49]   -0.24    0.00 0.03  -0.26  -0.24  -0.22 20668    1
## yPred[50]   -0.40    0.00 0.03  -0.42  -0.40  -0.37 19431    1
## yPred[51]   -0.02    0.00 0.03  -0.04  -0.02   0.00 18749    1
## yPred[52]    0.02    0.00 0.03  -0.01   0.02   0.04 18005    1
## yPred[53]    0.52    0.00 0.04   0.49   0.52   0.54  8417    1
## yPred[54]    1.49    0.00 0.06   1.45   1.49   1.53  4959    1
## yPred[55]    0.02    0.00 0.03  -0.01   0.02   0.04 18005    1
## yPred[56]    0.52    0.00 0.04   0.49   0.52   0.54  8417    1
## yPred[57]    1.49    0.00 0.06   1.45   1.49   1.53  4959    1
## yPred[58]   -0.53    0.00 0.04  -0.56  -0.53  -0.51 16799    1
## yPred[59]   -0.12    0.00 0.03  -0.14  -0.12  -0.10 20147    1
## yPred[60]   -0.53    0.00 0.04  -0.56  -0.53  -0.51 16799    1
## yPred[61]   -0.12    0.00 0.03  -0.14  -0.12  -0.10 20147    1
## yPred[62]   -0.41    0.00 0.03  -0.43  -0.41  -0.38 19289    1
## yPred[63]    0.64    0.00 0.04   0.61   0.64   0.66  7409    1
## yPred[64]    1.15    0.00 0.05   1.11   1.15   1.18  5435    1
## yPred[65]   -0.41    0.00 0.03  -0.43  -0.41  -0.38 19289    1
## yPred[66]    0.64    0.00 0.04   0.61   0.64   0.66  7409    1
## yPred[67]   -0.17    0.00 0.03  -0.19  -0.17  -0.15 20546    1
## yPred[68]    0.81    0.00 0.04   0.78   0.81   0.84  6432    1
## yPred[69]   -0.17    0.00 0.03  -0.19  -0.17  -0.15 20546    1
## yPred[70]    0.81    0.00 0.04   0.78   0.81   0.84  6432    1
## yPred[71]    1.27    0.00 0.05   1.23   1.27   1.30  5230    1
## yPred[72]    0.67    0.00 0.04   0.64   0.67   0.69  7223    1
## yPred[73]    1.36    0.00 0.05   1.32   1.36   1.40  5101    1
## yPred[74]    0.67    0.00 0.04   0.64   0.67   0.69  7223    1
## yPred[75]    1.36    0.00 0.05   1.32   1.36   1.40  5101    1
## yPred[76]   -0.11    0.00 0.05  -0.14  -0.11  -0.07  5950    1
## yPred[77]    0.36    0.00 0.04   0.34   0.36   0.38  7450    1
## yPred[78]    1.08    0.00 0.02   1.06   1.08   1.10 22396    1
## yPred[79]   -0.11    0.00 0.05  -0.14  -0.11  -0.07  5950    1
## yPred[80]    0.37    0.00 0.05   0.35   0.37   0.40  7523    1
## yPred[81]    0.85    0.00 0.03   0.83   0.85   0.87 14073    1
## yPred[82]   -0.12    0.00 0.05  -0.15  -0.12  -0.09  5925    1
## yPred[83]    0.75    0.00 0.03   0.73   0.75   0.77 11734    1
## yPred[84]   -0.02    0.00 0.05  -0.06  -0.02   0.01  6112    1
## yPred[85]    0.66    0.00 0.03   0.64   0.66   0.68 10131    1
## yPred[86]    1.23    0.00 0.02   1.22   1.23   1.25 23269    1
## yPred[87]    0.02    0.00 0.05  -0.01   0.02   0.05  6218    1
## yPred[88]    0.92    0.00 0.03   0.90   0.92   0.94 16183    1
## yPred[89]    1.57    0.00 0.03   1.55   1.57   1.59 12193    1
## yPred[90]   -0.16    0.00 0.05  -0.20  -0.16  -0.13  5851    1
## yPred[91]    0.70    0.00 0.03   0.68   0.70   0.72 10850    1
## yPred[92]    1.42    0.00 0.02   1.41   1.42   1.44 17076    1
## yPred[93]   -0.23    0.00 0.05  -0.27  -0.23  -0.20  5748    1
## yPred[94]    0.70    0.00 0.03   0.68   0.70   0.72 10740    1
## yPred[95]    1.34    0.00 0.02   1.33   1.34   1.36 20531    1
## yPred[96]   -0.23    0.00 0.05  -0.27  -0.23  -0.20  5748    1
## yPred[97]    0.70    0.00 0.03   0.68   0.70   0.72 10740    1
## yPred[98]    1.34    0.00 0.02   1.33   1.34   1.36 20531    1
## yPred[99]    1.37    0.00 0.02   1.35   1.37   1.38 19465    1
## yPred[100]   1.47    0.00 0.02   1.45   1.47   1.48 15445    1
## yPred[101]   0.69    0.00 0.03   0.67   0.69   0.71 10614    1
## yPred[102]   1.33    0.00 0.02   1.31   1.33   1.34 21084    1
## yPred[103]   1.51    0.00 0.03   1.49   1.51   1.53 13969    1
## yPred[104]   0.43    0.00 0.04   0.40   0.43   0.45  7864    1
## yPred[105]   1.37    0.00 0.02   1.36   1.37   1.39 19172    1
## yPred[106]   1.36    0.00 0.02   1.34   1.36   1.37 19940    1
## yPred[107]   1.14    0.00 0.02   1.13   1.14   1.16 23199    1
## yPred[108]   1.32    0.00 0.02   1.31   1.32   1.34 21216    1
## yPred[109]   0.96    0.00 0.03   0.94   0.96   0.97 17549    1
## yPred[110]   1.24    0.00 0.02   1.23   1.24   1.26 23205    1
## yPred[111]   1.44    0.00 0.02   1.43   1.44   1.46 16322    1
## yPred[112]   2.37    0.00 0.04   2.34   2.37   2.39  5553    1
## yPred[113]   1.44    0.00 0.02   1.43   1.44   1.46 16322    1
## yPred[114]   2.37    0.00 0.04   2.34   2.37   2.39  5553    1
## yPred[115]   0.35    0.00 0.04   0.32   0.35   0.37  7378    1
## yPred[116]   1.36    0.00 0.02   1.35   1.36   1.38 19623    1
## yPred[117]   2.30    0.00 0.04   2.27   2.30   2.33  5695    1
## yPred[118]   2.96    0.00 0.06   2.92   2.96   3.00  4918    1
## yPred[119]   3.00    0.00 0.06   2.96   3.00   3.04  4897    1
## yPred[120]   0.35    0.00 0.04   0.32   0.35   0.37  7378    1
## yPred[121]   1.36    0.00 0.02   1.35   1.36   1.38 19623    1
## yPred[122]   2.30    0.00 0.04   2.27   2.30   2.33  5695    1
## yPred[123]   2.96    0.00 0.06   2.92   2.96   3.00  4918    1
## yPred[124]   3.00    0.00 0.06   2.96   3.00   3.04  4897    1
## yPred[125]   2.00    0.00 0.03   1.97   2.00   2.02  6776    1
## yPred[126]   2.64    0.00 0.05   2.61   2.64   2.68  5162    1
## yPred[127]   2.94    0.00 0.06   2.90   2.94   2.98  4930    1
## yPred[128]   2.00    0.00 0.03   1.97   2.00   2.02  6776    1
## yPred[129]   2.64    0.00 0.05   2.61   2.64   2.68  5162    1
## yPred[130]   2.17    0.00 0.04   2.14   2.17   2.19  6045    1
## yPred[131]   2.84    0.00 0.06   2.80   2.84   2.88  4994    1
## yPred[132]   3.08    0.00 0.06   3.04   3.08   3.12  4857    1
## yPred[133]   2.17    0.00 0.04   2.14   2.17   2.19  6045    1
## yPred[134]   2.31    0.00 0.04   2.28   2.31   2.34  5663    1
## yPred[135]   2.97    0.00 0.06   2.93   2.97   3.01  4913    1
## yPred[136]   3.24    0.00 0.07   3.19   3.24   3.28  4794    1
## yPred[137]   2.31    0.00 0.04   2.28   2.31   2.34  5663    1
## yPred[138]   1.36    0.00 0.05   1.33   1.36   1.39  5820    1
## yPred[139]   2.07    0.00 0.03   2.05   2.07   2.09 10664    1
## yPred[140]   2.55    0.00 0.03   2.53   2.55   2.57 21903    1
## yPred[141]   3.10    0.00 0.03   3.08   3.10   3.12 11584    1
## yPred[142]   1.42    0.00 0.04   1.39   1.42   1.45  5958    1
## yPred[143]   1.33    0.00 0.05   1.30   1.33   1.36  5756    1
## yPred[144]   2.75    0.00 0.03   2.73   2.75   2.77 19860    1
## yPred[145]   3.22    0.00 0.04   3.20   3.22   3.24  9974    1
## yPred[146]   1.28    0.00 0.05   1.25   1.28   1.32  5659    1
## yPred[147]   1.20    0.00 0.05   1.16   1.20   1.23  5514    1
## yPred[148]   2.04    0.00 0.03   2.02   2.04   2.06 10246    1
## yPred[149]   2.85    0.00 0.03   2.83   2.85   2.87 17332    1
## yPred[150]   3.12    0.00 0.03   3.09   3.12   3.14 11313    1
## yPred[151]   2.04    0.00 0.03   2.02   2.04   2.06 10246    1
## yPred[152]   2.86    0.00 0.03   2.84   2.86   2.88 16941    1
## yPred[153]   3.13    0.00 0.03   3.11   3.13   3.16 11092    1
## yPred[154]   1.59    0.00 0.04   1.56   1.59   1.62  6514    1
## yPred[155]   2.26    0.00 0.03   2.24   2.26   2.28 15182    1
## yPred[156]   2.89    0.00 0.03   2.87   2.89   2.91 16034    1
## yPred[157]   2.81    0.00 0.03   2.79   2.81   2.83 18271    1
## yPred[158]   2.85    0.00 0.03   2.83   2.85   2.87 17332    1
## yPred[159]   3.11    0.00 0.03   3.09   3.11   3.13 11440    1
## yPred[160]   1.38    0.00 0.05   1.35   1.38   1.41  5858    1
## yPred[161]   1.93    0.00 0.03   1.90   1.93   1.95  8754    1
## yPred[162]   2.72    0.00 0.03   2.70   2.72   2.74 20444    1
## yPred[163]   3.23    0.00 0.04   3.20   3.23   3.25  9882    1
## yPred[164]   1.27    0.00 0.05   1.23   1.27   1.30  5631    1
## yPred[165]   2.38    0.00 0.03   2.36   2.38   2.40 18526    1
## yPred[166]   2.87    0.00 0.03   2.85   2.87   2.89 16650    1
## yPred[167]   2.80    0.00 0.03   2.78   2.80   2.82 18530    1
## yPred[168]   3.04    0.00 0.03   3.02   3.04   3.07 12521    1
## yPred[169]   3.01    0.00 0.03   2.98   3.01   3.03 13245    1
## yPred[170]   3.14    0.00 0.03   3.12   3.14   3.17 10935    1
## yPred[171]   2.20    0.00 0.03   2.18   2.20   2.22 13517    1
## yPred[172]   2.80    0.00 0.03   2.78   2.80   2.82 18616    1
## yPred[173]   3.18    0.00 0.04   3.16   3.18   3.20 10463    1
## yPred[174]   2.20    0.00 0.03   2.18   2.20   2.22 13353    1
## yPred[175]   3.10    0.00 0.03   3.08   3.10   3.12 11512    1
## yPred[176]   2.50    0.00 0.03   2.48   2.50   2.52 21354    1
## yPred[177]   3.15    0.00 0.03   3.12   3.15   3.17 10895    1
## yPred[178]   1.98    0.00 0.03   1.96   1.98   2.01  9438    1
## yPred[179]   2.96    0.00 0.03   2.94   2.96   2.98 14259    1
## yPred[180]   1.50    0.00 0.04   1.47   1.50   1.53  6187    1
## yPred[181]   2.30    0.00 0.03   2.28   2.30   2.32 16323    1
## yPred[182]   2.97    0.00 0.03   2.95   2.97   2.99 14026    1
## yPred[183]   3.22    0.00 0.04   3.20   3.22   3.24  9966    1
## yPred[184]   3.22    0.00 0.04   3.20   3.22   3.24  9966    1
## yPred[185]   3.17    0.00 0.04   3.15   3.17   3.19 10594    1
## yPred[186]   3.31    0.00 0.04   3.29   3.31   3.34  9053    1
## yPred[187]   3.31    0.00 0.04   3.29   3.31   3.34  9053    1
## yPred[188]   3.47    0.00 0.04   3.44   3.47   3.50  7917    1
## yPred[189]   3.47    0.00 0.04   3.44   3.47   3.50  7917    1
## yPred[190]   3.08    0.00 0.05   3.05   3.08   3.12  8729    1
## yPred[191]   3.71    0.00 0.04   3.68   3.71   3.74 17303    1
## yPred[192]   3.21    0.00 0.04   3.18   3.21   3.24  9949    1
## yPred[193]   3.83    0.00 0.04   3.80   3.83   3.85 18995    1
## yPred[194]   3.09    0.00 0.05   3.06   3.09   3.12  8756    1
## yPred[195]   3.73    0.00 0.04   3.71   3.73   3.76 17679    1
## yPred[196]   4.26    0.00 0.04   4.23   4.26   4.29 17869    1
## yPred[197]   3.14    0.00 0.05   3.11   3.14   3.17  9223    1
## yPred[198]   3.82    0.00 0.04   3.80   3.82   3.85 18963    1
## yPred[199]   4.36    0.00 0.05   4.33   4.36   4.40 16435    1
## yPred[200]   3.72    0.00 0.04   3.69   3.72   3.75 17421    1
## yPred[201]   4.27    0.00 0.04   4.24   4.27   4.30 17719    1
## yPred[202]   4.44    0.00 0.05   4.41   4.44   4.47 15417    1
## yPred[203]   3.42    0.00 0.04   3.39   3.42   3.45 12565    1
## yPred[204]   3.99    0.00 0.04   3.96   3.99   4.02 20026    1
## yPred[205]   3.15    0.00 0.04   3.12   3.15   3.18  9267    1
## yPred[206]   3.64    0.00 0.04   3.61   3.64   3.67 16090    1
## yPred[207]   4.16    0.00 0.04   4.13   4.16   4.19 19026    1
## yPred[208]   3.94    0.00 0.04   3.91   3.94   3.97 19938    1
## yPred[209]   4.34    0.00 0.04   4.31   4.34   4.37 16740    1
## yPred[210]   3.22    0.00 0.04   3.19   3.22   3.25 10061    1
## yPred[211]   3.90    0.00 0.04   3.87   3.90   3.92 19687    1
## yPred[212]   4.42    0.00 0.05   4.39   4.42   4.45 15696    1
## yPred[213]   3.13    0.00 0.05   3.10   3.13   3.16  9127    1
## yPred[214]   3.87    0.00 0.04   3.85   3.87   3.90 19483    1
## yPred[215]   4.36    0.00 0.05   4.33   4.36   4.40 16441    1
## yPred[216]   3.59    0.00 0.04   3.56   3.59   3.62 15248    1
## yPred[217]   3.32    0.00 0.04   3.29   3.32   3.35 11216    1
## yPred[218]   4.18    0.00 0.04   4.15   4.18   4.21 18782    1
## yPred[219]   4.18    0.00 0.04   4.15   4.18   4.21 18782    1
## yPred[220]   4.22    0.00 0.04   4.19   4.22   4.25 18343    1
## yPred[221]   4.06    0.00 0.04   4.03   4.06   4.09 19822    1
## yPred[222]   3.93    0.00 0.04   3.90   3.93   3.96 19884    1
## yPred[223]   3.93    0.00 0.04   3.90   3.93   3.96 19884    1
## yPred[224]  -1.87    0.00 0.05  -1.90  -1.87  -1.83 18484    1
## yPred[225]  -0.75    0.00 0.04  -0.77  -0.75  -0.72 12829    1
## yPred[226]  -0.35    0.00 0.03  -0.37  -0.35  -0.32 20003    1
## yPred[227]  -0.11    0.00 0.05  -0.14  -0.11  -0.07  5950    1
## yPred[228]   0.36    0.00 0.04   0.34   0.36   0.38  7450    1
## yPred[229]   1.08    0.00 0.02   1.06   1.08   1.10 22396    1
## yPred[230]   1.36    0.00 0.05   1.33   1.36   1.39  5820    1
## yPred[231]   2.07    0.00 0.03   2.05   2.07   2.09 10664    1
## yPred[232]   2.55    0.00 0.03   2.53   2.55   2.57 21903    1
## yPred[233]   3.10    0.00 0.03   3.08   3.10   3.12 11584    1
## yPred[234]   3.08    0.00 0.05   3.05   3.08   3.12  8729    1
## yPred[235]   3.71    0.00 0.04   3.68   3.71   3.74 17303    1
## yPred[236]  -2.19    0.00 0.06  -2.23  -2.19  -2.15 14888    1
## yPred[237]  -0.13    0.00 0.03  -0.15  -0.13  -0.11 20250    1
## yPred[238]  -0.11    0.00 0.05  -0.14  -0.11  -0.07  5950    1
## yPred[239]   0.37    0.00 0.04   0.35   0.37   0.40  7523    1
## yPred[240]   0.85    0.00 0.03   0.83   0.85   0.87 14073    1
## yPred[241]   1.42    0.00 0.04   1.39   1.42   1.45  5958    1
## yPred[242]   1.33    0.00 0.05   1.30   1.33   1.36  5756    1
## yPred[243]   2.12    0.00 0.03   2.10   2.12   2.14 11566    1
## yPred[244]   2.75    0.00 0.03   2.73   2.75   2.77 19860    1
## yPred[245]   3.22    0.00 0.04   3.20   3.22   3.24  9974    1
## yPred[246]   3.21    0.00 0.04   3.18   3.21   3.24  9949    1
## yPred[247]   3.83    0.00 0.04   3.80   3.83   3.85 18995    1
## yPred[248]  -1.69    0.00 0.05  -1.72  -1.69  -1.65 19277    1
## yPred[249]  -0.35    0.00 0.03  -0.37  -0.35  -0.33 19968    1
## yPred[250]  -0.12    0.00 0.05  -0.15  -0.12  -0.09  5925    1
## yPred[251]   0.75    0.00 0.03   0.73   0.75   0.77 11734    1
## yPred[252]   1.28    0.00 0.05   1.25   1.28   1.32  5659    1
## yPred[253]   1.20    0.00 0.05   1.16   1.20   1.23  5514    1
## yPred[254]   2.04    0.00 0.03   2.02   2.04   2.06 10246    1
## yPred[255]   2.85    0.00 0.03   2.83   2.85   2.87 17332    1
## yPred[256]   3.12    0.00 0.03   3.09   3.12   3.14 11313    1
## yPred[257]   3.09    0.00 0.05   3.06   3.09   3.12  8756    1
## yPred[258]   3.73    0.00 0.04   3.71   3.73   3.76 17679    1
## yPred[259]   4.26    0.00 0.04   4.23   4.26   4.29 17869    1
## yPred[260]  -2.00    0.00 0.05  -2.04  -2.00  -1.97 17341    1
## yPred[261]  -0.34    0.00 0.03  -0.36  -0.34  -0.31 20104    1
## yPred[262]  -0.02    0.00 0.05  -0.06  -0.02   0.01  6112    1
## yPred[263]   0.66    0.00 0.03   0.64   0.66   0.68 10131    1
## yPred[264]   1.23    0.00 0.02   1.22   1.23   1.25 23269    1
## yPred[265]   1.14    0.00 0.05   1.10   1.14   1.17  5426    1
## yPred[266]   2.86    0.00 0.03   2.84   2.86   2.88 16941    1
## yPred[267]   3.13    0.00 0.03   3.11   3.13   3.16 11092    1
## yPred[268]   3.14    0.00 0.05   3.11   3.14   3.17  9223    1
## yPred[269]   3.82    0.00 0.04   3.80   3.82   3.85 18963    1
## yPred[270]   4.36    0.00 0.05   4.33   4.36   4.40 16435    1
## yPred[271]   0.02    0.00 0.05  -0.01   0.02   0.05  6218    1
## yPred[272]   0.92    0.00 0.03   0.90   0.92   0.94 16183    1
## yPred[273]   1.57    0.00 0.03   1.55   1.57   1.59 12193    1
## yPred[274]   1.59    0.00 0.04   1.56   1.59   1.62  6514    1
## yPred[275]   2.89    0.00 0.03   2.87   2.89   2.91 16034    1
## yPred[276]   2.85    0.00 0.03   2.83   2.85   2.87 17332    1
## yPred[277]   3.11    0.00 0.03   3.09   3.11   3.13 11440    1
## yPred[278]   3.72    0.00 0.04   3.69   3.72   3.75 17421    1
## yPred[279]   4.27    0.00 0.04   4.24   4.27   4.30 17719    1
## yPred[280]   4.44    0.00 0.05   4.41   4.44   4.47 15417    1
## yPred[281]  -1.35    0.00 0.05  -1.38  -1.35  -1.32 17741    1
## yPred[282]  -0.36    0.00 0.03  -0.38  -0.36  -0.33 19894    1
## yPred[283]  -0.26    0.00 0.03  -0.28  -0.26  -0.24 20621    1
## yPred[284]   1.37    0.00 0.02   1.36   1.37   1.39 19172    1
## yPred[285]   2.50    0.00 0.03   2.48   2.50   2.52 21354    1
## yPred[286]   3.15    0.00 0.03   3.12   3.15   3.17 10895    1
## yPred[287]   3.59    0.00 0.04   3.56   3.59   3.62 15248    1
## yPred[288]  -1.50    0.00 0.05  -1.54  -1.50  -1.47 18942    1
## yPred[289]  -0.63    0.00 0.04  -0.65  -0.63  -0.60 14827    1
## yPred[290]  -0.24    0.00 0.03  -0.26  -0.24  -0.22 20668    1
## yPred[291]   0.01    0.00 0.05  -0.02   0.01   0.04  6190    1
## yPred[292]   1.14    0.00 0.02   1.13   1.14   1.16 23199    1
## yPred[293]   1.32    0.00 0.02   1.31   1.32   1.34 21216    1
## yPred[294]   1.98    0.00 0.03   1.96   1.98   2.01  9438    1
## yPred[295]   2.96    0.00 0.03   2.94   2.96   2.98 14259    1
## yPred[296]   3.32    0.00 0.04   3.29   3.32   3.35 11216    1
## yPred[297]  -1.27    0.00 0.05  -1.31  -1.28  -1.24 16914    1
## yPred[298]  -0.40    0.00 0.03  -0.42  -0.40  -0.37 19431    1
## yPred[299]  -0.02    0.00 0.03  -0.04  -0.02   0.00 18749    1
## yPred[300]   0.43    0.00 0.04   0.40   0.43   0.45  7854    1
## yPred[301]   0.96    0.00 0.03   0.94   0.96   0.97 17549    1
## yPred[302]   1.24    0.00 0.02   1.23   1.24   1.26 23205    1
## yPred[303]   1.50    0.00 0.04   1.47   1.50   1.53  6187    1
## yPred[304]   2.30    0.00 0.03   2.28   2.30   2.32 16323    1
## yPred[305]   2.97    0.00 0.03   2.95   2.97   2.99 14026    1
## lp__       123.07    0.02 1.45 122.37 123.39 124.13  6321    1
##
## Samples were drawn using NUTS(diag_e) at Wed Feb 21 19:28:30 2024.
## For each parameter, n_eff is a crude measure of effective sample size,
## and Rhat is the potential scale reduction factor on split chains (at
## convergence, Rhat=1).
```

step 3

```
traceplot(fit, inc_warmup = FALSE, nrow = 4, window = c(8000, 10000), pars = c("beta0", "beta1", "beta2", "sigm
a"))
```



step 4

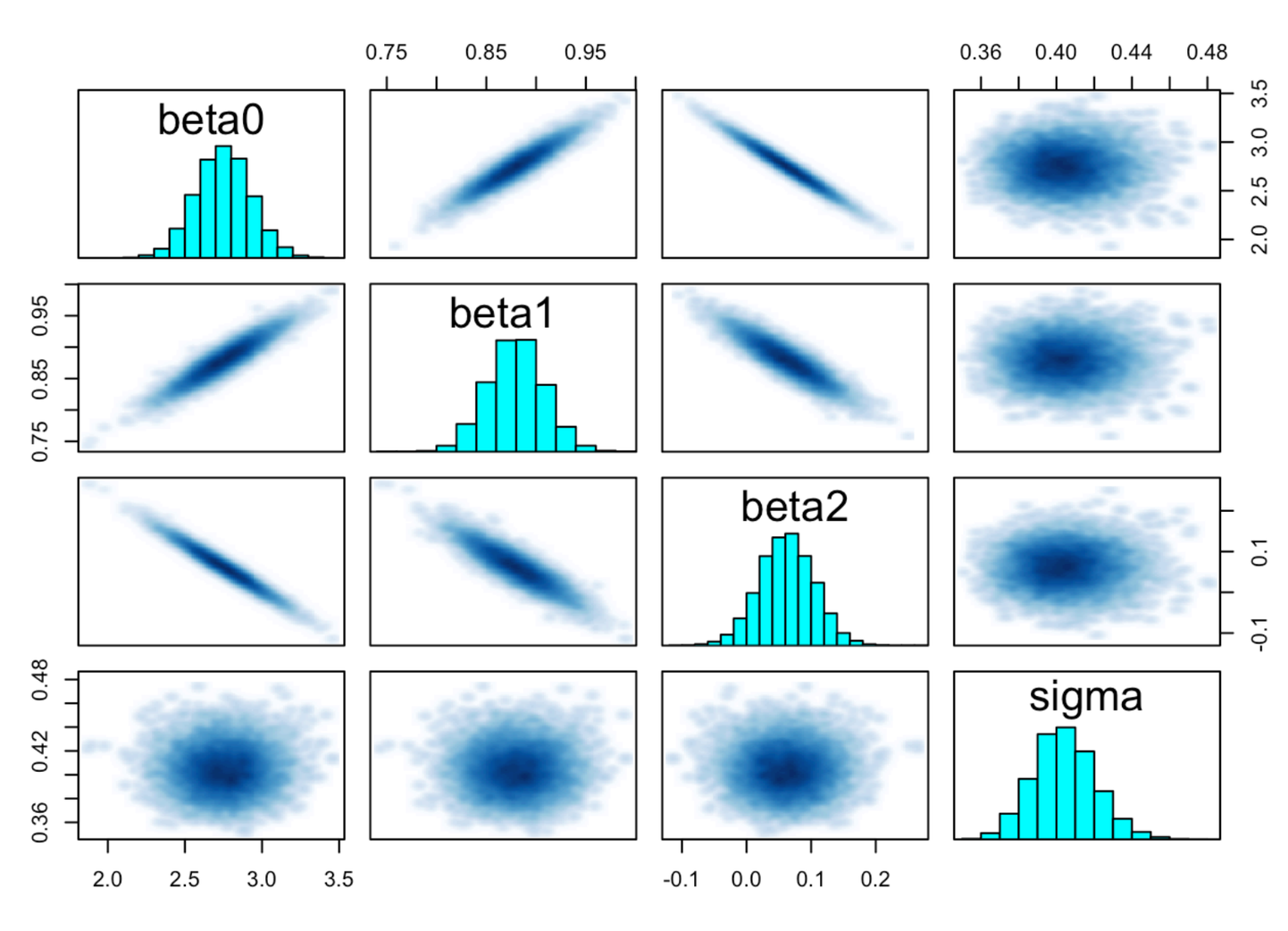
```
pairs(fit, pars = c("beta0", "beta1", "beta2", "sigma"))
```

```
## Warning in par(usr): argument 1 does not name a graphical parameter

## Warning in par(usr): argument 1 does not name a graphical parameter

## Warning in par(usr): argument 1 does not name a graphical parameter

## Warning in par(usr): argument 1 does not name a graphical parameter
```



step 6

```
library(bayesplot)
```

```
## This is bayesplot version 1.11.1
```

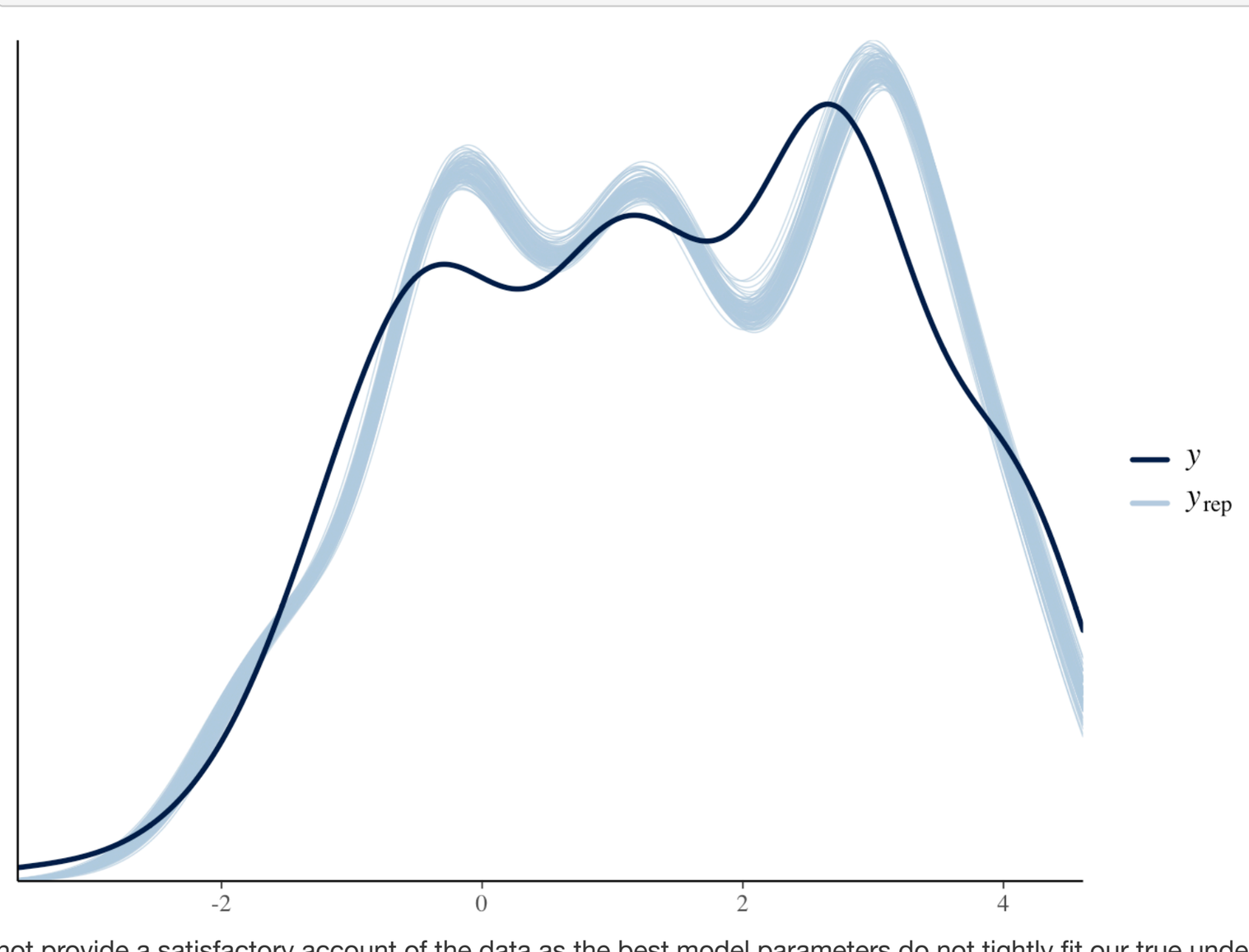
```
## - Online documentation and vignettes at mc-stan.org/bayesplot
```

```
## - bayesplot theme set to bayesplot::theme_default()
```

```
##    * Does _not_ affect other ggplot2 plots
```

```
##    * See ?bayesplot_theme_set for details on theme setting
```

```
yrep = as.matrix(extract(fit)[["yPred"]])
idx = sample(nrow(yrep), 100)
ppc_dens_overlay(log_rate, yrep[idx, ])
```



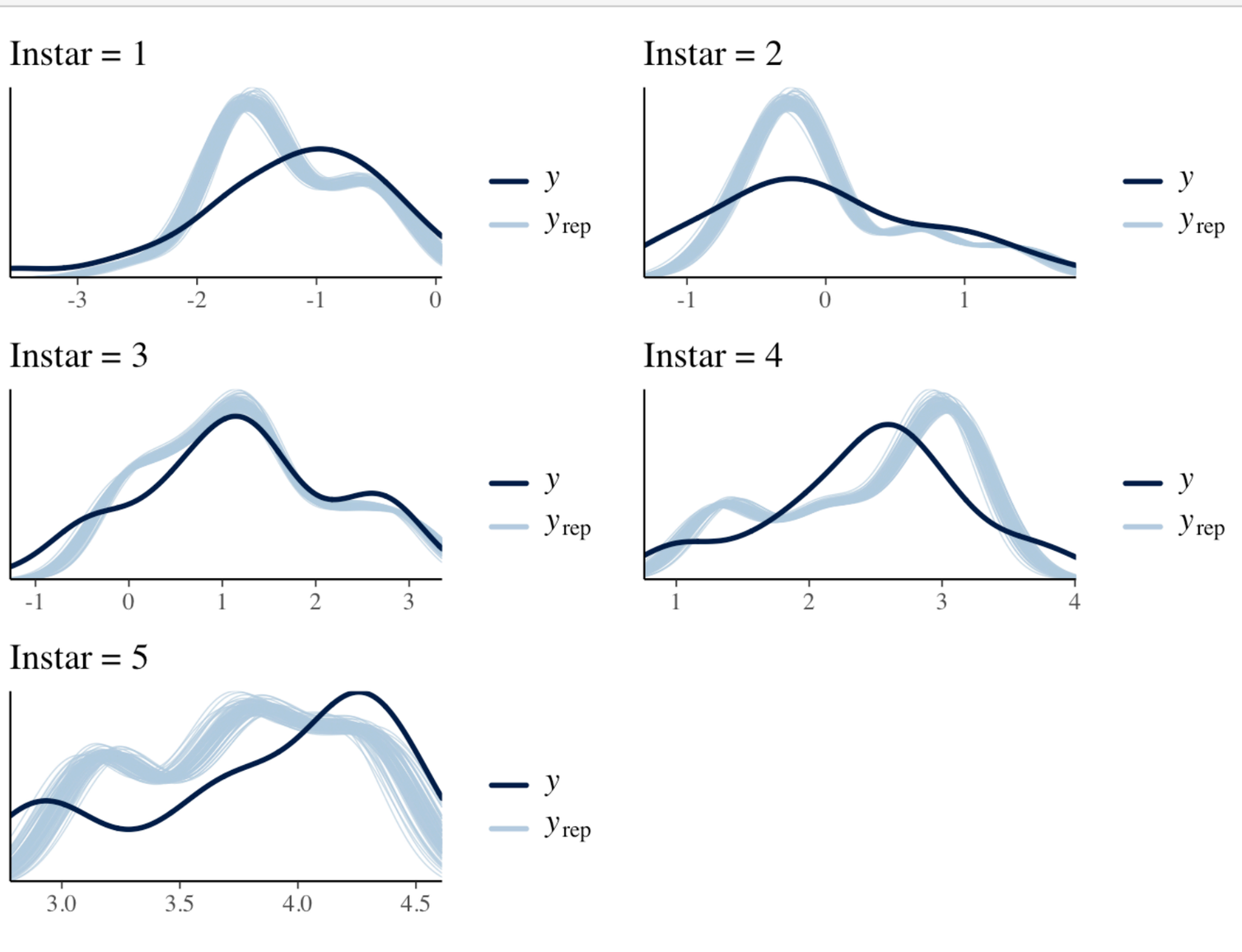
No, this linear regression model does not provide a satisfactory account of the data as the best model parameters do not tightly fit our true underlying distribution.

step 7

```
library(gridExtra)
library(ggplot2)

plot1 = ppc_dens_overlay(log_rate[instar == 1], yrep[idx,  instar==1]) + ggtitle("Instar = 1")
plot2 = ppc_dens_overlay(log_rate[instar == 2], yrep[idx,  instar==2]) + ggtitle("Instar = 2")
plot3 = ppc_dens_overlay(log_rate[instar == 3], yrep[idx,  instar==3]) + ggtitle("Instar = 3")
plot4 = ppc_dens_overlay(log_rate[instar == 4], yrep[idx,  instar==4]) + ggtitle("Instar = 4")
plot5 = ppc_dens_overlay(log_rate[instar == 5], yrep[idx,  instar==5]) + ggtitle("Instar = 5")

grid.arrange(plot1, plot2, plot3, plot4, plot5)
```



Yes, because looking at our plots we see that models fit differently based on instar. For example, instar equals 3 and 5 are better fit more closely around the true distribution y compared to instar equals 1 or 2 for example.