Supplementary material - code

Léa Orsini

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```
library(tidyverse)
```

```
## Warning: le package 'tidyverse' a été compilé avec la version R 4.2.3
## Warning: le package 'ggplot2' a été compilé avec la version R 4.2.3
## Warning: le package 'tibble' a été compilé avec la version R 4.2.3
## Warning: le package 'tidyr' a été compilé avec la version R 4.2.3
## Warning: le package 'readr' a été compilé avec la version R 4.2.3
## Warning: le package 'purrr' a été compilé avec la version R 4.2.3
## Warning: le package 'dplyr' a été compilé avec la version R 4.2.3
## Warning: le package 'stringr' a été compilé avec la version R 4.2.3
## Warning: le package 'forcats' a été compilé avec la version R 4.2.3
## Warning: le package 'lubridate' a été compilé avec la version R 4.2.3
```

```
library(pseudo)
library(geepack)
library(rstan)
```

```
## Warning: le package 'rstan' a été compilé avec la version R 4.2.3
## Warning: le package 'StanHeaders' a été compilé avec la version R 4.2.3
```

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

setwd("~/pseudoGMM_RMST")

source('MCMC_traceplot.R')
```

```
## Warning: le package 'plyr' a été compilé avec la version R 4.2.3
## Warning: le package 'coda' a été compilé avec la version R 4.2.2
## Warning: le package 'bayesplot' a été compilé avec la version R 4.2.3
## Warning: le package 'survminer' a été compilé avec la version R 4.2.3
## Warning: le package 'ggpubr' a été compilé avec la version R 4.2.3
## Warning: le package 'broom' a été compilé avec la version R 4.2.3
```

Data generation

```
s = 1
n = 200
set.seed(s)
  U <- runif(n)
  Trt <- rbinom(n, 1, 0.5)
  shape = 0.61*(Trt == 0) + 0.8*(Trt == 1)
  scale = 0.28*(Trt == 0) + 0.18*(Trt == 1)

  Z1 <- rnorm(n,0, 1) # runif(n,0,2)
  Z2 <- rbinom(n, 1, 0.5)
  b1 <- log(2)
  b2 <- log(1.5)

  X1 <- rnorm(n)
  X2 <- rbinom(n, 1, 0.5)

  T_tilde = (-(log(U))/((scale)^(1/shape)*exp(b1*Z1 + b2*Z2)))^shape
  C = runif(n, 0, 11)

  time <- pmin(T_tilde, C, 8)
  event <- as.numeric(time ==T_tilde)

  simu <- data.frame(time = time,
                     event = event,
                     patID = 1:n,
                     Trt = Trt,
                     Z1 = Z1,
                     Z2 = Z2,
                     X1 = X1,
                     X2 = X2)
```

Data Analysis with the Bayesian GMM

Without covariable adjustment

```
tau = 5 # truncation time (5 years)

  np = 2 #nb of parameters
  n = length(simu$patID) #sample size
  simu.tau = min(tau, min(max(simu$time[simu$Trt == 1]), max(simu$time[simu$Trt == 0])))
  #compute the pseudo-observations
  simu$rmst<-pseudomean(simu$time, simu$event, tmax = simu.tau)

  X = matrix(c(rep(1,n), simu$Trt),
             nrow = n, ncol = np)

  data <- list(X = X, Y = simu$rmst, n = n, N = n, np = np)

  #fit a GMM with independence working matrix
  GMM <- stan_model("GMM_ind_single_tau.stan")
  fit <- sampling(GMM, data = data, chains = 3, iter = 2000, warmup = 1000, seed = 1, init_r = 1, cores
```

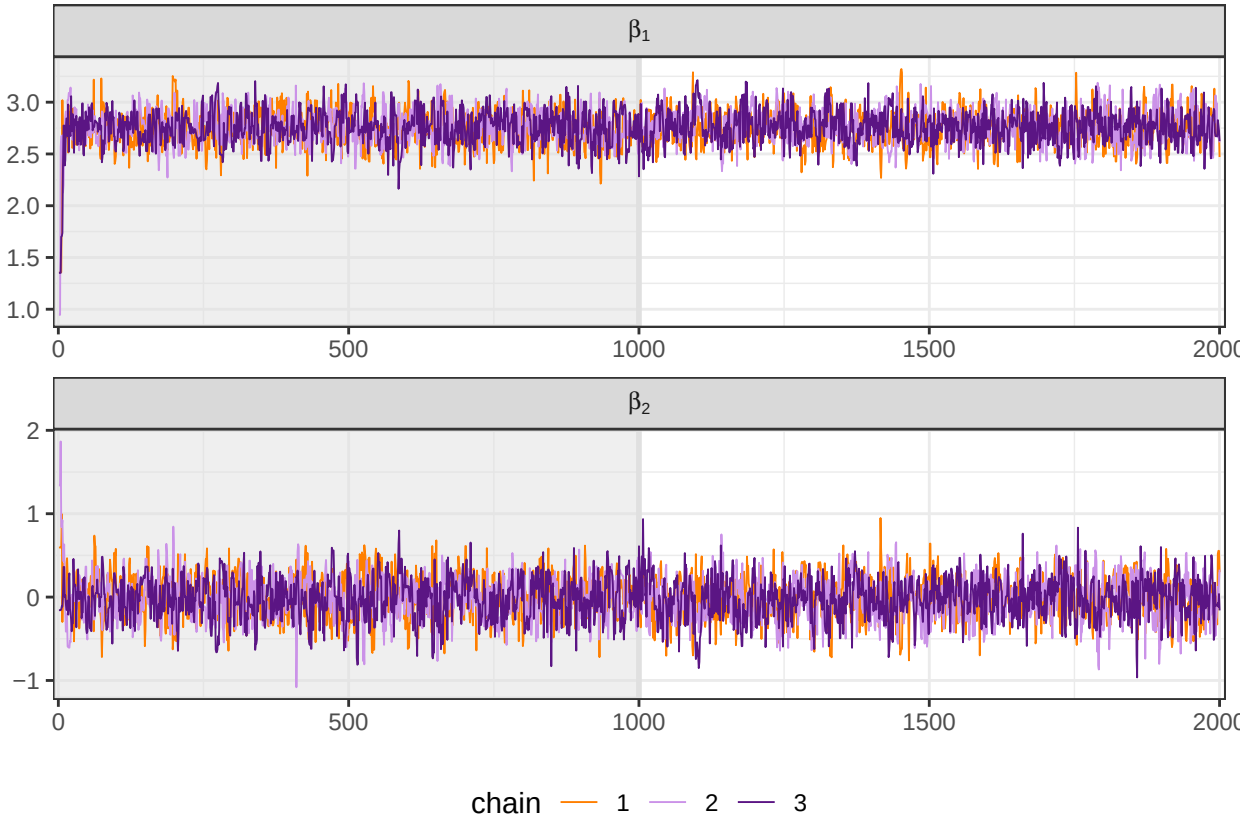
```
                save_warmup = T, refresh = 1000)

summary(fit)
```

```
## $summary
##                     mean      se_mean           sd         2.5%          25%
## beta[1]       2.761974373 4.630210e-03 1.571415e-01  2.455701764  2.654427528
## beta[2]      -0.021878856 7.800103e-03 2.535319e-01 -0.527940051 -0.185899936
## loglik       -1.014736919 2.825121e-02 9.954402e-01 -3.744435603 -1.417752907
## Sigma_n[1,1]  0.014573341 3.082905e-06 1.108702e-04  0.014495986  0.014503876
## Sigma_n[1,2]  0.006177005 1.779891e-06 7.756490e-05  0.006111835  0.006131203
## Sigma_n[2,1]  0.006177005 1.779891e-06 7.756490e-05  0.006111835  0.006131203
## Sigma_n[2,2]  0.006175847 1.562189e-06 6.553504e-05  0.006130519  0.006134577
## C_n[1,1]      0.014645614 4.187748e-06 1.487087e-04  0.014499755  0.014540655
## C_n[1,2]      0.006206740 2.625527e-06 1.101429e-04  0.006130559  0.006137379
## C_n[2,1]      0.006206740 2.625527e-06 1.101429e-04  0.006130559  0.006137379
## C_n[2,2]      0.006206740 2.625527e-06 1.101429e-04  0.006130559  0.006137379
## lp__         -1.400633085 2.865194e-02 1.003363e+00 -4.148991904 -1.811698008
##                      50%          75%        97.5%    n_eff     Rhat
## beta[1]       2.759159841  2.866637760  3.077192549 1151.808 1.001589
## beta[2]      -0.015956814  0.155459876  0.460018587 1056.488 1.001327
## loglik       -0.708035200 -0.303536264 -0.026374716 1241.527 1.000992
## Sigma_n[1,1]  0.014531151  0.014598050  0.014884848 1293.329 1.000972
## Sigma_n[1,2]  0.006148574  0.006193491  0.006397007 1899.082 1.000399
## Sigma_n[2,1]  0.006148574  0.006193491  0.006397007 1899.082 1.000399
## Sigma_n[2,2]  0.006150759  0.006189956  0.006371489 1759.868 1.000206
## C_n[1,1]      0.014599504  0.014705542  0.015051165 1260.989 1.000890
## C_n[1,2]      0.006164576  0.006230454  0.006535552 1759.868 1.000206
## C_n[2,1]      0.006164576  0.006230454  0.006535552 1759.868 1.000206
## C_n[2,2]      0.006164576  0.006230454  0.006535552 1759.868 1.000206
## lp__         -1.088415706 -0.683995852 -0.405034454 1226.332 1.000991
##
## $c_summary
## , , chains = chain:1
##
##               stats
## parameter              mean           sd         2.5%          25%          50%
##   beta[1]       2.753127254 1.603578e-01  2.437558860  2.640370916  2.756190269
##   beta[2]      -0.015288594 2.522506e-01 -0.519914464 -0.183104499 -0.012104625
##   loglik       -1.026905159 1.029405e+00 -3.940753435 -1.463717873 -0.690024485
##   Sigma_n[1,1]  0.014572490 1.076045e-04  0.014495984  0.014504577  0.014531087
##   Sigma_n[1,2]  0.006175436 7.242916e-05  0.006113341  0.006131758  0.006149891
##   Sigma_n[2,1]  0.006175436 7.242916e-05  0.006113341  0.006131758  0.006149891
##   Sigma_n[2,2]  0.006174870 6.263442e-05  0.006130519  0.006134657  0.006151824
##   C_n[1,1]      0.014647206 1.528224e-04  0.014500178  0.014540458  0.014596892
##   C_n[1,2]      0.006205099 1.052679e-04  0.006130559  0.006137514  0.006166367
##   C_n[2,1]      0.006205099 1.052679e-04  0.006130559  0.006137514  0.006166367
##   C_n[2,2]      0.006205099 1.052679e-04  0.006130559  0.006137514  0.006166367
##   lp__         -1.410365113 1.035466e+00 -4.362269841 -1.824250220 -1.068662873
##               stats
## parameter              75%        97.5%
##   beta[1]       2.855696317  3.074991342
##   beta[2]       0.158425113  0.460082842
##   loglik       -0.302578844 -0.028769901
```

```
##   Sigma_n[1,1]  0.014596834  0.014871045
##   Sigma_n[1,2]  0.006192701  0.006362028
##   Sigma_n[2,1]  0.006192701  0.006362028
##   Sigma_n[2,2]  0.006186637  0.006365776
##   C_n[1,1]      0.014710891  0.015071707
##   C_n[1,2]      0.006224875  0.006525949
##   C_n[2,1]      0.006224875  0.006525949
##   C_n[2,2]      0.006224875  0.006525949
##   lp__         -0.679691829 -0.406294921
##
## , , chains = chain:2
##
##               stats
## parameter           mean           sd         2.5%          25%          50%
##   beta[1]       2.767293608 1.535082e-01  2.456994438  2.661763489  2.760499368
##   beta[2]      -0.028189179 2.586651e-01 -0.517326638 -0.207381193 -0.027352536
##   loglik       -1.029983844 9.678091e-01 -3.646808824 -1.429370078 -0.742517298
##   Sigma_n[1,1]  0.014576571 1.086648e-04  0.014496026  0.014503628  0.014533576
##   Sigma_n[1,2]  0.006181088 7.906222e-05  0.006111784  0.006131630  0.006149451
##   Sigma_n[2,1]  0.006181088 7.906222e-05  0.006111784  0.006131630  0.006149451
##   Sigma_n[2,2]  0.006179436 6.895324e-05  0.006130507  0.006135564  0.006152588
##   C_n[1,1]      0.014648319 1.454152e-04  0.014499151  0.014541980  0.014605518
##   C_n[1,2]      0.006212773 1.158878e-04  0.006130539  0.006139039  0.006167650
##   C_n[2,1]      0.006212773 1.158878e-04  0.006130539  0.006139039  0.006167650
##   C_n[2,2]      0.006212773 1.158878e-04  0.006130539  0.006139039  0.006167650
##   lp__         -1.417438367 9.756595e-01 -4.043385714 -1.827572608 -1.125481023
##               stats
## parameter           75%        97.5%
##   beta[1]       2.870645322  3.081782323
##   beta[2]       0.152231322  0.471562579
##   loglik       -0.316388851 -0.022096603
##   Sigma_n[1,1]  0.014606040  0.014870053
##   Sigma_n[1,2]  0.006205470  0.006405016
##   Sigma_n[2,1]  0.006205470  0.006405016
##   Sigma_n[2,2]  0.006197261  0.006383871
##   C_n[1,1]      0.014709776  0.015044652
##   C_n[1,2]      0.006242730  0.006556361
##   C_n[2,1]      0.006242730  0.006556361
##   C_n[2,2]      0.006242730  0.006556361
##   lp__         -0.690861861 -0.400099200
##
## , , chains = chain:3
##
##               stats
## parameter           mean           sd         2.5%          25%          50%
##   beta[1]       2.765502258 1.572616e-01  2.468785017  2.656711838  2.760207416
##   beta[2]      -0.022158796 2.496848e-01 -0.542037104 -0.179255658 -0.014451337
##   loglik       -0.987321755 9.885467e-01 -3.704690726 -1.367735376 -0.689311837
##   Sigma_n[1,1]  0.014570962 1.161791e-04  0.014495974  0.014502998  0.014529103
##   Sigma_n[1,2]  0.006174490 8.086211e-05  0.006112062  0.006130771  0.006145969
##   Sigma_n[2,1]  0.006174490 8.086211e-05  0.006112062  0.006130771  0.006145969
##   Sigma_n[2,2]  0.006173234 6.476740e-05  0.006130529  0.006133848  0.006148535
##   C_n[1,1]      0.014641317 1.478461e-04  0.014499735  0.014539281  0.014596186
##   C_n[1,2]      0.006202349 1.088528e-04  0.006130577  0.006136154  0.006160838
```

```
##   C_n[2,1]      0.006202349 1.088528e-04  0.006130577  0.006136154  0.006160838
##   C_n[2,2]      0.006202349 1.088528e-04  0.006130577  0.006136154  0.006160838
##   lp__         -1.374095776 9.985205e-01 -3.998752409 -1.751546780 -1.066314184
##                stats
## parameter             75%        97.5%
##   beta[1]       2.871909900  3.077367699
##   beta[2]       0.157225692  0.442571404
##   loglik       -0.291204092 -0.026803616
##   Sigma_n[1,1]  0.014590052  0.014891892
##   Sigma_n[1,2]  0.006184275  0.006396439
##   Sigma_n[2,1]  0.006184275  0.006396439
##   Sigma_n[2,2]  0.006186363  0.006342046
##   C_n[1,1]      0.014697506  0.015041670
##   C_n[1,2]      0.006224415  0.006486067
##   C_n[2,1]      0.006224415  0.006486067
##   C_n[2,2]      0.006224415  0.006486067
##   lp__         -0.675224422 -0.407062807
```

```r
MCMC_traceplot(fit, c('beta[1]', 'beta[2]'))
```



With covariates adjustments

```r
np = 4  #nb of parameters
n = length(simu$patID)
simu.tau = min(tau, min(max(simu$time[simu$Trt == 1]), max(simu$time[simu$Trt == 0])))
#compute the pseudo-observations
```

```r
simu$rmst<-pseudomean(simu$time, simu$event, tmax = simu.tau)

X = matrix(c(rep(1,n), simu$Trt, simu$Z1, simu$Z2),
             nrow = n, ncol = np)


data <- list(X = X, Y = simu$rmst, n = n, N = n, np = np)

#fit a GMM with independence working matrix
GMM <- stan_model("GMM_ind_single_tau.stan")
fit <- sampling(GMM, data = data, chains = 3, iter = 2000, warmup = 1000, seed = 1, init_r = 1, cores =
                save_warmup = T, refresh = 1000)

summary(fit, c('beta[1]', 'beta[2]', 'beta[3]', 'beta[4]'))
```

```
## $summary
##               mean     se_mean        sd       2.5%         25%        50%
## beta[1]  2.9540974 0.005018810 0.1861586  2.5955115  2.82719933  2.9535350
## beta[2]  0.1732505 0.005050838 0.2287608 -0.2774066  0.02054917  0.1765520
## beta[3] -0.7709282 0.002110713 0.1058734 -0.9780248 -0.84351363 -0.7696884
## beta[4] -0.5276528 0.005201831 0.2127319 -0.9491606 -0.67131191 -0.5261116
##                75%      97.5%    n_eff      Rhat
## beta[1]  3.0785239  3.3278200 1375.830 1.0007288
## beta[2]  0.3343891  0.6147117 2051.333 1.0004189
## beta[3] -0.7004957 -0.5701211 2516.026 0.9997914
## beta[4] -0.3820136 -0.1227919 1672.448 1.0015541
##
## $c_summary
## , , chains = chain:1
##
##          stats
## parameter       mean        sd       2.5%         25%        50%        75%
##   beta[1]  2.9549072 0.1887723  2.5911437  2.82798828  2.9556018  3.0765087
##   beta[2]  0.1714923 0.2276161 -0.2665657  0.01894498  0.1695766  0.3270774
##   beta[3] -0.7681728 0.1067679 -0.9774929 -0.84473781 -0.7653101 -0.6939492
##   beta[4] -0.5321434 0.2182482 -0.9627798 -0.68163811 -0.5263027 -0.3838414
##          stats
## parameter      97.5%
##   beta[1]  3.3325290
##   beta[2]  0.6195108
##   beta[3] -0.5741417
##   beta[4] -0.1101182
##
## , , chains = chain:2
##
##          stats
## parameter       mean        sd       2.5%          25%        50%        75%
##   beta[1]  2.9526095 0.1870667  2.6023559  2.820663545  2.9482229  3.0806480
##   beta[2]  0.1622171 0.2282766 -0.2787305  0.005698821  0.1627164  0.3299335
##   beta[3] -0.7713113 0.1051982 -0.9777381 -0.844526925 -0.7719289 -0.7015365
##   beta[4] -0.5263961 0.2114555 -0.9427642 -0.675811834 -0.5245449 -0.3817802
##          stats
## parameter      97.5%
##   beta[1]  3.3123095
```

```
##   beta[2]  0.5910822
##   beta[3] -0.5648475
##   beta[4] -0.1289649
##
## , , chains = chain:3
##
##          stats
## parameter       mean        sd       2.5%         25%        50%        75%
##   beta[1]  2.9547756 0.1827627  2.5959493  2.83238963  2.9569740  3.0727130
##   beta[2]  0.1860422 0.2299808 -0.2745304  0.03600071  0.1921720  0.3465467
##   beta[3] -0.7733004 0.1056907 -0.9796632 -0.84050701 -0.7700801 -0.7038971
##   beta[4] -0.5244188 0.2085120 -0.9333820 -0.65712731 -0.5273655 -0.3813274
##          stats
## parameter      97.5%
##   beta[1]  3.3344582
##   beta[2]  0.6170123
##   beta[3] -0.5718877
##   beta[4] -0.1328086
```

```
MCMC_traceplot(fit, c('beta[1]', 'beta[2]', 'beta[3]', 'beta[4]'))
```