元器件生存时间模拟分析-代码

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# A1

## 数据模拟生成

set.seed(123)  
  
alpha = matrix(c(0.001, 0.05, 0.0001, 0.08), ncol = 2, byrow = TRUE)  
w = c(45, 55)  
t = matrix(seq(10, 40, 10), ncol = 2, byrow = TRUE)  
K = c(10, 50, 100)  
  
  
lambda = function(r = 1:2, j = 1:2) {  
 alpha\_r0 = alpha[r, 1]  
 alpha\_r1 = alpha[r, 2]  
 return(alpha\_r0\*exp(alpha\_r1\*w[j]))  
}  
  
p = function(i = 1:2, j = 1:2){  
 lam1j = lambda(1, j) # failure due to factor 1  
 lam2j = lambda(2, j) # failure due to factor 2  
   
 p0 = exp(-(lam1j + lam2j)\*t[i, j])  
 p1 = (lam1j/(lam1j + lam2j))\*(1 - p0)  
 p2 = (lam2j/(lam1j + lam2j))\*(1 - p0)  
   
 return(c(p0, p1, p2))  
}  
  
Tmatrxi = t(rmultinom(100, K[3], prob = p(1, 1)))

## Stan代码

reliab = "  
data {  
 int<lower=0> n;  
 int DAT[n, 3];  
 vector[2] W;  
 vector[4] Tim;  
}  
parameters{  
 real<lower=0, upper=0.5> a10;   
 real<lower=0, upper=0.5> a11;  
 real<lower=0, upper=0.5> a20;   
 real<lower=0, upper=0.5> a21;  
}  
transformed parameters{  
 real<lower=0, upper=1> p0;   
 real<lower=0, upper=1> p1;   
 real<lower=0, upper=1> p2;  
 vector<lower=0, upper=1>[3] p;  
   
 p0 = exp(-(a10\*exp(a11\*W[1]) + a20\*exp(a21\*W[2]))\*Tim[1]);  
 p1 = (a10\*exp(a11\*W[1]))/(a10\*exp(a11\*W[1]) + a20\*exp(a21\*W[2]))\*(1 - p0);  
 p2 = 1-p0-p1;  
 p = [p0, p1, p2]';  
}  
model{  
 for (i in 1:n){  
 //target += multinomial\_lpmf(DAT[i,] | p);  
 DAT[i,] ~ multinomial(p);  
 //DAT[i,] ~ multi\_log(p0, p1, p2);  
 }  
 a10 ~ gamma(1, 10);  
 a11 ~ gamma(1, 10);  
 a20 ~ gamma(1, 10);  
 a21 ~ gamma(1, 10);  
}  
"

## Stan抽样

# N = 10  
set.seed(123)  
Tmatrxi = t(rmultinom(10, 10, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit10 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
# N = 50  
set.seed(123)  
Tmatrxi = t(rmultinom(50, 50, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit50 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
# N = 100  
set.seed(123)  
Tmatrxi = t(rmultinom(100, 100, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit100 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
# N = 500  
set.seed(123)  
Tmatrxi = t(rmultinom(500, 500, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit500 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
  
# N = 1000  
set.seed(123)  
Tmatrxi = t(rmultinom(1000, 1000, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit1000 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
# write out tables  
wtab = function(fit, filename){  
 dat = as.data.frame(summary(fit)$summary[1:7,])  
 write.csv(dat, paste0('data/', filename))  
}  
  
wtab(fit10, 'fit10.csv')  
wtab(fit50, 'fit50.csv')  
wtab(fit100, 'fit100.csv')  
wtab(fit500, 'fit500.csv')  
wtab(fit1000, 'fit1000.csv')  
  
saveRDS(fit10, 'data/fit10.rds')  
saveRDS(fit50, 'data/fit50.rds')  
saveRDS(fit100, 'data/fit100.rds')  
saveRDS(fit500, 'data/fit500.rds')  
saveRDS(fit1000, 'data/fit1000.rds')  
  
plot(fit10, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('figs/fit10.png', dpi = 300, height = 6.18, width = 10)  
plot(fit50, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('figs/fit50.png', dpi = 300, height = 6.18, width = 10)  
plot(fit100, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('figs/fit100.png', dpi = 300, height = 6.18, width = 10)  
plot(fit500, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('figs/fit500.png', dpi = 300, height = 6.18, width = 10)  
plot(fit1000, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('figs/fit1000.png', dpi = 300, height = 6.18, width = 10)

# A2

## 数据模拟生成

set.seed(123)  
  
alpha = matrix(c(0.005, 0.05, 0.0005, 0.08), ncol = 2, byrow = TRUE)  
w = c(45, 55)  
t = matrix(seq(10, 40, 10), ncol = 2, byrow = TRUE)  
K = c(10, 50, 100)  
  
  
lambda = function(r = 1:2, j = 1:2) {  
 alpha\_r0 = alpha[r, 1]  
 alpha\_r1 = alpha[r, 2]  
 return(alpha\_r0\*exp(alpha\_r1\*w[j]))  
}  
  
p = function(i = 1:2, j = 1:2){  
 lam1j = lambda(1, j) # failure due to factor 1  
 lam2j = lambda(2, j) # failure due to factor 2  
   
 p0 = exp(-(lam1j + lam2j)\*t[i, j])  
 p1 = (lam1j/(lam1j + lam2j))\*(1 - p0)  
 p2 = (lam2j/(lam1j + lam2j))\*(1 - p0)  
   
 return(c(p0, p1, p2))  
}  
  
Tmatrxi = t(rmultinom(100, K[3], prob = p(1, 1)))

## Stan代码

reliab = "  
data {  
 int<lower=0> n;  
 int DAT[n, 3];  
 vector[2] W;  
 vector[4] Tim;  
}  
parameters{  
 real<lower=0, upper=0.5> a10;   
 real<lower=0, upper=0.5> a11;  
 real<lower=0, upper=0.5> a20;   
 real<lower=0, upper=0.5> a21;  
}  
transformed parameters{  
 real<lower=0, upper=1> p0;   
 real<lower=0, upper=1> p1;   
 real<lower=0, upper=1> p2;  
 vector<lower=0, upper=1>[3] p;  
   
 p0 = exp(-(a10\*exp(a11\*W[1]) + a20\*exp(a21\*W[2]))\*Tim[1]);  
 p1 = (a10\*exp(a11\*W[1]))/(a10\*exp(a11\*W[1]) + a20\*exp(a21\*W[2]))\*(1 - p0);  
 p2 = 1-p0-p1;  
 p = [p0, p1, p2]';  
}  
model{  
 for (i in 1:n){  
 //target += multinomial\_lpmf(DAT[i,] | p);  
 DAT[i,] ~ multinomial(p);  
 //DAT[i,] ~ multi\_log(p0, p1, p2);  
 }  
 a10 ~ gamma(1, 10);  
 a11 ~ gamma(1, 10);  
 a20 ~ gamma(1, 10);  
 a21 ~ gamma(1, 10);  
}  
"

## Stan抽样

# N = 10  
set.seed(123)  
Tmatrxi = t(rmultinom(10, 10, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit10 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
# N = 50  
set.seed(123)  
Tmatrxi = t(rmultinom(50, 50, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit50 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
# N = 100  
set.seed(123)  
Tmatrxi = t(rmultinom(100, 100, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit100 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
# N = 500  
set.seed(123)  
Tmatrxi = t(rmultinom(500, 500, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit500 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
  
# N = 1000  
set.seed(123)  
Tmatrxi = t(rmultinom(1000, 1000, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit1000 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
# write out tables  
wtab = function(fit, filename){  
 dat = as.data.frame(summary(fit)$summary[1:7,])  
 write.csv(dat, paste0('data/A2/', filename))  
}  
  
wtab(fit10, 'fit10.csv')  
wtab(fit50, 'fit50.csv')  
wtab(fit100, 'fit100.csv')  
wtab(fit500, 'fit500.csv')  
wtab(fit1000, 'fit1000.csv')  
  
saveRDS(fit10, 'data/A2/fit10.rds')  
saveRDS(fit50, 'data/A2/fit50.rds')  
saveRDS(fit100, 'data/A2/fit100.rds')  
saveRDS(fit500, 'data/A2/fit500.rds')  
saveRDS(fit1000, 'data/A2/fit1000.rds')  
  
plot(fit10, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A2/fit10.png', dpi = 300, height = 6.18, width = 10)  
plot(fit50, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A2/fit50.png', dpi = 300, height = 6.18, width = 10)  
plot(fit100, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A2/fit100.png', dpi = 300, height = 6.18, width = 10)  
plot(fit500, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A2/fit500.png', dpi = 300, height = 6.18, width = 10)  
plot(fit1000, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A2/fit1000.png', dpi = 300, height = 6.18, width = 10)

# A3

## 数据模拟生成

set.seed(123)  
  
alpha = matrix(c(0.008, 0.05, 0.0008, 0.08), ncol = 2, byrow = TRUE)  
w = c(45, 55)  
t = matrix(seq(10, 40, 10), ncol = 2, byrow = TRUE)  
K = c(10, 50, 100)  
  
  
lambda = function(r = 1:2, j = 1:2) {  
 alpha\_r0 = alpha[r, 1]  
 alpha\_r1 = alpha[r, 2]  
 return(alpha\_r0\*exp(alpha\_r1\*w[j]))  
}  
  
p = function(i = 1:2, j = 1:2){  
 lam1j = lambda(1, j) # failure due to factor 1  
 lam2j = lambda(2, j) # failure due to factor 2  
   
 p0 = exp(-(lam1j + lam2j)\*t[i, j])  
 p1 = (lam1j/(lam1j + lam2j))\*(1 - p0)  
 p2 = (lam2j/(lam1j + lam2j))\*(1 - p0)  
   
 return(c(p0, p1, p2))  
}  
  
Tmatrxi = t(rmultinom(100, K[3], prob = p(1, 1)))

## Stan代码

reliab = "  
data {  
 int<lower=0> n;  
 int DAT[n, 3];  
 vector[2] W;  
 vector[4] Tim;  
}  
parameters{  
 real<lower=0, upper=0.5> a10;   
 real<lower=0, upper=0.5> a11;  
 real<lower=0, upper=0.5> a20;   
 real<lower=0, upper=0.5> a21;  
}  
transformed parameters{  
 real<lower=0, upper=1> p0;   
 real<lower=0, upper=1> p1;   
 real<lower=0, upper=1> p2;  
 vector<lower=0, upper=1>[3] p;  
   
 p0 = exp(-(a10\*exp(a11\*W[1]) + a20\*exp(a21\*W[2]))\*Tim[1]);  
 p1 = (a10\*exp(a11\*W[1]))/(a10\*exp(a11\*W[1]) + a20\*exp(a21\*W[2]))\*(1 - p0);  
 p2 = 1-p0-p1;  
 p = [p0, p1, p2]';  
}  
model{  
 for (i in 1:n){  
 //target += multinomial\_lpmf(DAT[i,] | p);  
 DAT[i,] ~ multinomial(p);  
 //DAT[i,] ~ multi\_log(p0, p1, p2);  
 }  
 a10 ~ gamma(1, 10);  
 a11 ~ gamma(1, 10);  
 a20 ~ gamma(1, 10);  
 a21 ~ gamma(1, 10);  
}  
"

## Stan抽样

# N = 10  
set.seed(123)  
Tmatrxi = t(rmultinom(10, 10, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit10 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
# N = 50  
set.seed(123)  
Tmatrxi = t(rmultinom(50, 50, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit50 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
# N = 100  
set.seed(123)  
Tmatrxi = t(rmultinom(100, 100, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit100 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
# N = 500  
set.seed(123)  
Tmatrxi = t(rmultinom(500, 500, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit500 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
  
  
# N = 1000  
set.seed(123)  
Tmatrxi = t(rmultinom(1000, 1000, prob = p(1, 1)))  
  
stan\_dat = list(  
 n = nrow(Tmatrxi),  
 DAT = Tmatrxi,  
 W = w,  
 Tim = seq(10, 40, 10)  
)  
  
fit1000 <- stan(  
 model\_code = reliab, data = stan\_dat, #init\_r = 0.1, init = 0.001,   
 warmup = 1000, iter = 2000, chains = 3, cores = 3, seed = 3,   
 control = list(adapt\_delta = 0.95, max\_treedepth = 15))  
  
# write out tables  
wtab = function(fit, filename){  
 dat = as.data.frame(summary(fit)$summary[1:7,])  
 write.csv(dat, paste0('data/A3/', filename))  
}  
  
wtab(fit10, 'fit10.csv')  
wtab(fit50, 'fit50.csv')  
wtab(fit100, 'fit100.csv')  
wtab(fit500, 'fit500.csv')  
wtab(fit1000, 'fit1000.csv')  
  
saveRDS(fit10, 'data/A3/fit10.rds')  
saveRDS(fit50, 'data/A3/fit50.rds')  
saveRDS(fit100, 'data/A3/fit100.rds')  
saveRDS(fit500, 'data/A3/fit500.rds')  
saveRDS(fit1000, 'data/A3/fit1000.rds')  
  
plot(fit10, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A3/fit10.png', dpi = 300, height = 6.18, width = 10)  
plot(fit50, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A3/fit50.png', dpi = 300, height = 6.18, width = 10)  
plot(fit100, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A3/fit100.png', dpi = 300, height = 6.18, width = 10)  
plot(fit500, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A3/fit500.png', dpi = 300, height = 6.18, width = 10)  
plot(fit1000, plotfun = "trace", #inc\_warmup = TRUE,  
 pars = c("a10", "a11", "a20", "a21", "p0", "p1", "p2"))  
ggsave('data/A3/fit1000.png', dpi = 300, height = 6.18, width = 10)