No screening

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```
########################################
####improved r code for cvd screening#####
########################################

################################
#####no screening
################################

###1. transition matrix
library(openxlsx)
rate_data <-read.csv("data/ghdx_data.csv")
source("function/transform_func.R")
p1_0 <- RateToProb(rate_data$incidence, 1)
p2_0 <- RateToProb(rate_data$death_CVD, 1)
p3 <- RateToProb(rate_data$death_nonCVD, 1)
p5_0 <- ProbFactor(p1_0, 3.12)
p7 <- ProbFactor(p1_0, 1.37)

n_state=4
names_state=c("s1","s2","s3","s4")
n_population=14
names_population=c("m_40","m_45","m_50","m_55",
                   "m_60","m_65","m_70","f_40",
                   "f_45","f_50","f_55","f_60",
                   "f_65","f_70")

a_P<-array(0,
           dim=c(n_state,n_state,10,n_population),
           dimnames=list(names_state,names_state,1:10,names_population))
p1 <- array(0,
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))
##s1 to s2
p2 <- array(0,
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))
##s1 to s3
p4 <- array(0,
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))
##s1 being s1
set.seed(1)
```

```r
p8 <- array(runif(140,min=0.02,max=0.1),
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))  ##cvd Probability of acute death


p5 <- array(0,
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))
##s2 to s4

p6 <- array(0,
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))
## s2 being s2

for (i in 1:14){
  if (i==7 | i==14){
    a_P["s1","s3",1:10,i]<-p3[i]
    a_P["s2","s3",1:10,i]<-p3[i]
    for ( j in 1:10){
      p2[j,i]<-p2_0[i]+p1_0[i]*p7[i]*p8[j,i]
      p1[j,i]<-p1_0[i]*(1-p7[i]*p8[j,i])
      p4[j,i]<-1-p1[j,i]-p2[j,i]-p3[i]
      p5[j,i]<-p5_0[i]+p7[i]*p8[j,i]
      p6[j,i]<-1-p5[j,i]-p3[i]
      a_P["s1","s2",j,i]<-p1[j,i]
      a_P["s1","s4",j,i]<-p2[j,i]
      a_P["s1","s1",j,i]<-p4[j,i]
      a_P["s2","s2",j,i]<-p6[j,i]
      a_P["s2","s4",j,i]<-p5[j,i]
    }
    a_P["s3","s3",1:10,i]<-1
    a_P["s4","s4",1:10,i]<-1
  }
  else{
    ### the first 5 years
    a_P["s1","s3",1:5,i]<-p3[i]
    a_P["s2","s3",1:5,i]<-p3[i]
    for ( j in 1:5){
      p2[j,i]<-p2_0[i]+p1_0[i]*p7[i]*p8[j,i]
      p1[j,i]<-p1_0[i]*(1-p7[i]*p8[j,i])
      p4[j,i]<-1-p1[j,i]-p2[j,i]-p3[i]
      p5[j,i]<-p5_0[i]+p7[i]*p8[j,i]
      p6[j,i]<-1-p5[j,i]-p3[i]
      a_P["s1","s2",j,i]<-p1[j,i]
      a_P["s1","s4",j,i]<-p2[j,i]
      a_P["s1","s1",j,i]<-p4[j,i]
      a_P["s2","s2",j,i]<-p6[j,i]
      a_P["s2","s4",j,i]<-p5[j,i]
    }
    a_P["s3","s3",1:5,i]<-1
    a_P["s4","s4",1:5,i]<-1
```

```
    ## the second 5 years
    a_P["s1","s3",6:10,i]<-p3[i+1]
    a_P["s2","s3",6:10,i]<-p3[i+1]
    for ( j in 6:10){
      p2[j,i]<-p2_0[i+1]+p1_0[i+1]*p7[i+1]*p8[j,i]
      p1[j,i]<-p1_0[i+1]*(1-p7[i+1]*p8[j,i])
      p4[j,i]<-1-p1[j,i]-p2[j,i]-p3[i+1]
      p5[j,i]<-p5_0[i+1]+p7[i+1]*p8[j,i]
      p6[j,i]<-1-p5[j,i]-p3[i]
      a_P["s1","s2",j,i]<-p1[j,i]
      a_P["s1","s4",j,i]<-p2[j,i]
      a_P["s1","s1",j,i]<-p4[j,i]
      a_P["s2","s2",j,i]<-p6[j,i]
      a_P["s2","s4",j,i]<-p5[j,i]
    }
    a_P["s3","s3",6:10,i]<-1
    a_P["s4","s4",6:10,i]<-1
  }
}

a_P
```

```
## , , 1, m_40
##
##         s1          s2          s3           s4
## s1 0.99281 0.003879602 0.002490893 0.0008195143
## s2 0.00000 0.985281955 0.002490893 0.0122271526
## s3 0.00000 0.000000000 1.000000000 0.0000000000
## s4 0.00000 0.000000000 0.000000000 1.0000000000
##
## , , 2, m_40
##
##         s1          s2          s3         s4
## s1 0.99281 0.003879426 0.002490893 0.00081969
## s2 0.00000 0.985236677 0.002490893 0.01227243
## s3 0.00000 0.000000000 1.000000000 0.00000000
## s4 0.00000 0.000000000 0.000000000 1.00000000
##
## , , 3, m_40
##
##         s1          s2          s3           s4
## s1 0.99281 0.003879095 0.002490893 0.0008200208
## s2 0.00000 0.985151429 0.002490893 0.0123576781
## s3 0.00000 0.000000000 1.000000000 0.0000000000
## s4 0.00000 0.000000000 0.000000000 1.0000000000
##
## , , 4, m_40
##
##         s1          s2          s3           s4
## s1 0.99281 0.003878543 0.002490893 0.0008205734
## s2 0.00000 0.985009008 0.002490893 0.0125000990
## s3 0.00000 0.000000000 1.000000000 0.0000000000
## s4 0.00000 0.000000000 0.000000000 1.0000000000
```

```
##
## , , 5, m_40
##
##         s1          s2          s3           s4
## s1 0.99281 0.003879707 0.002490893 0.0008194091
## s2 0.00000 0.985309061 0.002490893 0.0122000462
## s3 0.00000 0.000000000 1.000000000 0.0000000000
## s4 0.00000 0.000000000 0.000000000 1.0000000000
##
## , , 6, m_40
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006700764 0.00339323 0.001344749
## s2 0.0000000 0.976036421 0.00339323 0.021472687
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 7, m_40
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006700537 0.00339323 0.001344977
## s2 0.0000000 0.976002484 0.00339323 0.021506623
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 8, m_40
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006701932 0.00339323 0.001343581
## s2 0.0000000 0.976210624 0.00339323 0.021298484
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 9, m_40
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006702088 0.00339323 0.001343425
## s2 0.0000000 0.976233855 0.00339323 0.021275253
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 10, m_40
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006704878 0.00339323 0.001340636
## s2 0.0000000 0.976649821 0.00339323 0.020859286
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 1, m_45
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006704169 0.00339323 0.001341345
## s2 0.0000000 0.975641764 0.00339323 0.020965006
```

```
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 2, m_45
##
##           s1          s2         s3         s4
## s1 0.9885613 0.006704314 0.00339323 0.00134120
## s2 0.0000000 0.975663334 0.00339323 0.02094344
## s3 0.0000000 0.000000000 1.00000000 0.00000000
## s4 0.0000000 0.000000000 0.00000000 1.00000000
##
## , , 3, m_45
##
##           s1          s2         s3         s4
## s1 0.9885613 0.006701803 0.00339323 0.00134371
## s2 0.0000000 0.975289058 0.00339323 0.02131771
## s3 0.0000000 0.000000000 1.00000000 0.00000000
## s4 0.0000000 0.000000000 0.00000000 1.00000000
##
## , , 4, m_45
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006703293 0.00339323 0.001342221
## s2 0.0000000 0.975511160 0.00339323 0.021095611
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 5, m_45
##
##           s1          s2         s3          s4
## s1 0.9885613 0.006701396 0.00339323 0.001344117
## s2 0.0000000 0.975228335 0.00339323 0.021378435
## s3 0.0000000 0.000000000 1.00000000 0.000000000
## s4 0.0000000 0.000000000 0.00000000 1.000000000
##
## , , 6, m_45
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01049938 0.004938764 0.002308367
## s2 0.0000000 0.96367725 0.004938764 0.032929516
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 7, m_45
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01049673 0.004938764 0.002311018
## s2 0.0000000 0.96342495 0.004938764 0.033181821
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 8, m_45
##
##           s1         s2          s3          s4
```

```
## s1 0.9822535 0.01049342 0.004938764 0.002314325
## s2 0.0000000 0.96311027 0.004938764 0.033496500
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 9, m_45
##
##           s1        s2          s3          s4
## s1 0.9822535 0.0105008 0.004938764 0.002306948
## s2 0.0000000 0.9638122 0.004938764 0.032794525
## s3 0.0000000 0.0000000 1.000000000 0.000000000
## s4 0.0000000 0.0000000 0.000000000 1.000000000
##
## , , 10, m_45
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01049601 0.004938764 0.002311739
## s2 0.0000000 0.96335631 0.004938764 0.033250458
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 1, m_50
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01049411 0.004938764 0.002313635
## s2 0.0000000 0.96163036 0.004938764 0.033430876
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 2, m_50
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01050283 0.004938764 0.002304924
## s2 0.0000000 0.96245933 0.004938764 0.032601909
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 3, m_50
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01049753 0.004938764 0.002310223
## s2 0.0000000 0.96195507 0.004938764 0.033106165
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 4, m_50
##
##           s1         s2          s3         s4
## s1 0.9822535 0.01050387 0.004938764 0.00230388
## s2 0.0000000 0.96255867 0.004938764 0.03250257
## s3 0.0000000 0.00000000 1.000000000 0.00000000
## s4 0.0000000 0.00000000 0.000000000 1.00000000
##
## , , 5, m_50
```

```
##
##           s1         s2          s3          s4
## s1 0.9822535 0.01050216 0.004938764 0.002305588
## s2 0.0000000 0.96239614 0.004938764 0.032665098
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 6, m_50
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01515872 0.00725555 0.003674257
## s2 0.0000000 0.94813980 0.00725555 0.046921431
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 7, m_50
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01516808 0.00725555 0.003664902
## s2 0.0000000 0.94875624 0.00725555 0.046304998
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 8, m_50
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01515882 0.00725555 0.003674163
## s2 0.0000000 0.94814597 0.00725555 0.046915269
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 9, m_50
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01514659 0.00725555 0.003686393
## s2 0.0000000 0.94734004 0.00725555 0.047721199
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 10, m_50
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01515987 0.00725555 0.003673108
## s2 0.0000000 0.94821549 0.00725555 0.046845742
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 1, m_55
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01515631 0.00725555 0.003676665
## s2 0.0000000 0.94566430 0.00725555 0.047080145
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
```

```
##
## , , 2, m_55
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01515336 0.00725555 0.003679613
## s2 0.0000000 0.94547000 0.00725555 0.047274450
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 3, m_55
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01515603 0.00725555 0.003676953
## s2 0.0000000 0.94564535 0.00725555 0.047099101
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 4, m_55
##
##           s1         s2         s3         s4
## s1 0.9739115 0.01516374 0.00725555 0.00366924
## s2 0.0000000 0.94615362 0.00725555 0.04659083
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 5, m_55
##
##           s1         s2         s3          s4
## s1 0.9739115 0.01514765 0.00725555 0.003685331
## s2 0.0000000 0.94509324 0.00725555 0.047651212
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 6, m_55
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02178845 0.01109697 0.006431151
## s2 0.0000000 0.92544974 0.01109697 0.067294712
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 7, m_55
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02178193 0.01109697 0.006437671
## s2 0.0000000 0.92515115 0.01109697 0.067593304
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 8, m_55
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02181751 0.01109697 0.006402094
## s2 0.0000000 0.92678045 0.01109697 0.065964001
```

```
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 9, m_55
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02178559 0.01109697 0.006434015
## s2 0.0000000 0.92531858 0.01109697 0.067425865
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 10, m_55
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02180178 0.01109697 0.006417819
## s2 0.0000000 0.92606033 0.01109697 0.066684124
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 1, m_60
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02178055 0.01109697 0.006439056
## s2 0.0000000 0.92124632 0.01109697 0.067656707
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 2, m_60
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02178956 0.01109697 0.006430042
## s2 0.0000000 0.92165914 0.01109697 0.067243892
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 3, m_60
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02178252 0.01109697 0.006437085
## s2 0.0000000 0.92133657 0.01109697 0.067566460
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 4, m_60
##
##           s1         s2         s3          s4
## s1 0.9606834 0.02179444 0.01109697 0.006425167
## s2 0.0000000 0.92188236 0.01109697 0.067020674
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 5, m_60
##
##           s1         s2         s3          s4
```

```
## s1 0.9606834 0.02179564 0.01109697 0.006423959
## s2 0.0000000 0.92193771 0.01109697 0.066965319
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
##
## , , 6, m_60
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03040022 0.01680322 0.01119783
## s2 0.0000000 0.89607237 0.01680322 0.09283066
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 7, m_60
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03047747 0.01680322 0.01112058
## s2 0.0000000 0.89860488 0.01680322 0.09029816
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 8, m_60
##
##           s1        s2         s3         s4
## s1 0.9415987 0.0304317 0.01680322 0.01116636
## s2 0.0000000 0.8971043 0.01680322 0.09179876
## s3 0.0000000 0.0000000 1.00000000 0.00000000
## s4 0.0000000 0.0000000 0.00000000 1.00000000
##
## , , 9, m_60
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03040597 0.01680322 0.01119208
## s2 0.0000000 0.89626095 0.01680322 0.09264208
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 10, m_60
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03040996 0.01680322 0.01118809
## s2 0.0000000 0.89639181 0.01680322 0.09251122
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 1, m_65
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03043166 0.01680322 0.01116639
## s2 0.0000000 0.89139673 0.01680322 0.09180005
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 2, m_65
```

```
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03039297 0.01680322 0.01120508
## s2 0.0000000 0.89012856 0.01680322 0.09306821
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 3, m_65
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03043564 0.01680322 0.01116241
## s2 0.0000000 0.89152739 0.01680322 0.09166939
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 4, m_65
##
##           s1         s2         s3         s4
## s1 0.9415987 0.03045514 0.01680322 0.01114291
## s2 0.0000000 0.89216645 0.01680322 0.09103033
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 5, m_65
##
##           s1        s2         s3         s4
## s1 0.9415987 0.0304727 0.01680322 0.01112535
## s2 0.0000000 0.8927421 0.01680322 0.09045469
## s3 0.0000000 0.0000000 1.00000000 0.00000000
## s4 0.0000000 0.0000000 0.00000000 1.00000000
##
## , , 6, m_65
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04258406 0.02596204 0.01984836
## s2 0.0000000 0.85954760 0.02596204 0.12364918
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 7, m_65
##
##           s1        s2         s3         s4
## s1 0.9116055 0.0425415 0.02596204 0.01989092
## s2 0.0000000 0.8585498 0.02596204 0.12464694
## s3 0.0000000 0.0000000 1.00000000 0.00000000
## s4 0.0000000 0.0000000 0.00000000 1.00000000
##
## , , 8, m_65
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04250178 0.02596204 0.01993064
## s2 0.0000000 0.85761854 0.02596204 0.12557823
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
```

```
##
## , , 9, m_65
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04247363 0.02596204 0.01995878
## s2 0.0000000 0.85695874 0.02596204 0.12623804
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 10, m_65
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04252372 0.02596204 0.01990869
## s2 0.0000000 0.85813308 0.02596204 0.12506370
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 1, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04242439 0.02596204 0.02000803
## s2 0.0000000 0.84664539 0.02596204 0.12739257
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 2, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04254595 0.02596204 0.01988647
## s2 0.0000000 0.84949535 0.02596204 0.12454262
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 3, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04251347 0.02596204 0.01991895
## s2 0.0000000 0.84873387 0.02596204 0.12530409
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 4, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04253833 0.02596204 0.01989408
## s2 0.0000000 0.84931682 0.02596204 0.12472114
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 5, m_70
##
##           s1         s2         s3        s4
## s1 0.9116055 0.04247582 0.02596204 0.0199566
## s2 0.0000000 0.84785117 0.02596204 0.1261868
```

```
## s3 0.0000000 0.00000000 1.00000000 0.0000000
## s4 0.0000000 0.00000000 0.00000000 1.0000000
##
## , , 6, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04255293 0.02596204 0.01987948
## s2 0.0000000 0.84965912 0.02596204 0.12437884
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 7, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04250965 0.02596204 0.01992277
## s2 0.0000000 0.84864422 0.02596204 0.12539374
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 8, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04245316 0.02596204 0.01997926
## s2 0.0000000 0.84731990 0.02596204 0.12671806
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 9, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04258704 0.02596204 0.01984537
## s2 0.0000000 0.85045883 0.02596204 0.12357914
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 10, m_70
##
##           s1         s2         s3         s4
## s1 0.9116055 0.04243176 0.02596204 0.02000065
## s2 0.0000000 0.84681822 0.02596204 0.12721974
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 1, f_40
##
##          s1          s2          s3           s4
## s1 0.993978 0.004533362 0.001136354 0.0003522638
## s2 0.000000 0.984557862 0.001136354 0.0143057843
## s3 0.000000 0.000000000 1.000000000 0.0000000000
## s4 0.000000 0.000000000 0.000000000 1.0000000000
##
## , , 2, f_40
##
##          s1          s2          s3           s4
```

```
## s1 0.993978 0.004532236 0.001136354 0.0003533896
## s2 0.000000 0.984309595 0.001136354 0.0145540512
## s3 0.000000 0.000000000 1.000000000 0.0000000000
## s4 0.000000 0.000000000 0.000000000 1.0000000000
##
## , , 3, f_40
##
##          s1          s2          s3           s4
## s1 0.993978 0.004533345 0.001136354 0.0003522809
## s2 0.000000 0.984554086 0.001136354 0.0143095604
## s3 0.000000 0.000000000 1.000000000 0.0000000000
## s4 0.000000 0.000000000 0.000000000 1.0000000000
##
## , , 4, f_40
##
##          s1          s2          s3           s4
## s1 0.993978 0.004533374 0.001136354 0.0003522519
## s2 0.000000 0.984560491 0.001136354 0.0143031556
## s3 0.000000 0.000000000 1.000000000 0.0000000000
## s4 0.000000 0.000000000 0.000000000 1.0000000000
##
## , , 5, f_40
##
##          s1          s2          s3           s4
## s1 0.993978 0.004533053 0.001136354 0.0003525727
## s2 0.000000 0.984489749 0.001136354 0.0143738976
## s3 0.000000 0.000000000 1.000000000 0.0000000000
## s4 0.000000 0.000000000 0.000000000 1.0000000000
##
## , , 6, f_40
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007062658 0.001618689 0.0006490324
## s2 0.0000000 0.976251714 0.001618689 0.0226119326
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 7, f_40
##
##           s1         s2          s3           s4
## s1 0.9906696 0.00706281 0.001618689 0.0006488802
## s2 0.0000000 0.97627324 0.001618689 0.0225904052
## s3 0.0000000 0.00000000 1.000000000 0.0000000000
## s4 0.0000000 0.00000000 0.000000000 1.0000000000
##
## , , 8, f_40
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007065401 0.001618689 0.0006462892
## s2 0.0000000 0.976639785 0.001618689 0.0222238608
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 9, f_40
```

```
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007063285 0.001618689 0.0006484049
## s2 0.0000000 0.976340483 0.001618689 0.0225231632
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 10, f_40
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007062284 0.001618689 0.0006494061
## s2 0.0000000 0.976198844 0.001618689 0.0226648025
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 1, f_45
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007065157 0.001618689 0.0006465332
## s2 0.0000000 0.976122933 0.001618689 0.0222583786
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 2, f_45
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007063639 0.001618689 0.0006480509
## s2 0.0000000 0.975908226 0.001618689 0.0224730856
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 3, f_45
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007065346 0.001618689 0.0006463438
## s2 0.0000000 0.976149720 0.001618689 0.0222315918
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 4, f_45
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007065754 0.001618689 0.0006459361
## s2 0.0000000 0.976207398 0.001618689 0.0221739135
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
##
## , , 5, f_45
##
##           s1          s2          s3           s4
## s1 0.9906696 0.007063396 0.001618689 0.0006482944
## s2 0.0000000 0.975873783 0.001618689 0.0225075281
## s3 0.0000000 0.000000000 1.000000000 0.0000000000
## s4 0.0000000 0.000000000 0.000000000 1.0000000000
```

```
##
## , , 6, f_45
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007681 0.00247194 0.001210297
## s2 0.000000 0.96708588 0.00247194 0.031295433
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 7, f_45
##
##          s1         s2         s3         s4
## s1 0.986241 0.01007117 0.00247194 0.00121594
## s2 0.000000 0.96652617 0.00247194 0.03185514
## s3 0.000000 0.00000000 1.00000000 0.00000000
## s4 0.000000 0.00000000 0.00000000 1.00000000
##
## , , 8, f_45
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007771 0.00247194 0.001209398
## s2 0.000000 0.96717505 0.00247194 0.031206263
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 9, f_45
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007633 0.00247194 0.001210772
## s2 0.000000 0.96703877 0.00247194 0.031342546
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 10, f_45
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007747 0.00247194 0.001209638
## s2 0.000000 0.96715126 0.00247194 0.031230055
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 1, f_50
##
##          s1        s2         s3          s4
## s1 0.986241 0.0100764 0.00247194 0.001210707
## s2 0.000000 0.9661920 0.00247194 0.031336096
## s3 0.000000 0.0000000 1.00000000 0.000000000
## s4 0.000000 0.0000000 0.00000000 1.000000000
##
## , , 2, f_50
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007841 0.00247194 0.001208702
## s2 0.000000 0.96639088 0.00247194 0.031137176
```

```
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 3, f_50
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007193 0.00247194 0.001215176
## s2 0.000000 0.96574869 0.00247194 0.031779368
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 4, f_50
##
##          s1         s2         s3          s4
## s1 0.986241 0.01006933 0.00247194 0.001217773
## s2 0.000000 0.96549111 0.00247194 0.032036949
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 5, f_50
##
##          s1         s2         s3          s4
## s1 0.986241 0.01007041 0.00247194 0.001216693
## s2 0.000000 0.96559829 0.00247194 0.031929775
## s3 0.000000 0.00000000 1.00000000 0.000000000
## s4 0.000000 0.00000000 0.00000000 1.000000000
##
## , , 6, f_50
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01361887 0.003698145 0.002033222
## s2 0.0000000 0.95460911 0.003698145 0.042918949
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 7, f_50
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362581 0.003698145 0.002026283
## s2 0.0000000 0.95511787 0.003698145 0.042410190
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 8, f_50
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362673 0.003698145 0.002025366
## s2 0.0000000 0.95518509 0.003698145 0.042342971
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 9, f_50
##
##           s1         s2          s3          s4
```

```
## s1 0.9806498 0.01361859 0.003698145 0.002033497
## s2 0.0000000 0.95458894 0.003698145 0.042939121
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 10, f_50
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362277 0.003698145 0.002029319
## s2 0.0000000 0.95489526 0.003698145 0.042632800
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 1, f_55
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362176 0.003698145 0.002030329
## s2 0.0000000 0.95359499 0.003698145 0.042706861
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 2, f_55
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362788 0.003698145 0.002024212
## s2 0.0000000 0.95404350 0.003698145 0.042258355
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 3, f_55
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362956 0.003698145 0.002022529
## s2 0.0000000 0.95416686 0.003698145 0.042134990
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 4, f_55
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01361491 0.003698145 0.002037186
## s2 0.0000000 0.95309230 0.003698145 0.043209560
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 5, f_55
##
##           s1         s2          s3          s4
## s1 0.9806498 0.01362219 0.003698145 0.002029898
## s2 0.0000000 0.95362657 0.003698145 0.042675281
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 6, f_55
```

```
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01808955 0.005832922 0.003881046
## s2 0.0000000 0.94098605 0.005832922 0.055315810
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 7, f_55
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01809254 0.005832922 0.003878054
## s2 0.0000000 0.94115130 0.005832922 0.055150551
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 8, f_55
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01808009 0.005832922 0.003890501
## s2 0.0000000 0.94046385 0.005832922 0.055838006
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 9, f_55
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01806418 0.005832922 0.003906417
## s2 0.0000000 0.93958477 0.005832922 0.056717084
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 10, f_55
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01807579 0.005832922 0.003894807
## s2 0.0000000 0.94022604 0.005832922 0.056075819
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 1, f_60
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01806232 0.005832922 0.003908277
## s2 0.0000000 0.93734730 0.005832922 0.056819777
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 2, f_60
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01807104 0.005832922 0.003899555
## s2 0.0000000 0.93782902 0.005832922 0.056338054
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
```

```
##
## , , 3, f_60
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01808442 0.005832922 0.003886168
## s2 0.0000000 0.93856836 0.005832922 0.055598717
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 4, f_60
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01808176 0.005832922 0.003888836
## s2 0.0000000 0.93842102 0.005832922 0.055746059
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 5, f_60
##
##           s1         s2          s3          s4
## s1 0.9721965 0.01809187 0.005832922 0.003878726
## s2 0.0000000 0.93897939 0.005832922 0.055187687
## s3 0.0000000 0.00000000 1.000000000 0.000000000
## s4 0.0000000 0.00000000 0.000000000 1.000000000
##
## , , 6, f_60
##
##          s1         s2          s3          s4
## s1 0.960545 0.02344859 0.009019082 0.006987323
## s2 0.000000 0.92375679 0.009019082 0.070410287
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 7, f_60
##
##          s1         s2          s3          s4
## s1 0.960545 0.02340657 0.009019082 0.007029349
## s2 0.000000 0.92196576 0.009019082 0.072201320
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 8, f_60
##
##          s1        s2          s3          s4
## s1 0.960545 0.0234432 0.009019082 0.006992714
## s2 0.000000 0.9235271 0.009019082 0.070640019
## s3 0.000000 0.0000000 1.000000000 0.000000000
## s4 0.000000 0.0000000 0.000000000 1.000000000
##
## , , 9, f_60
##
##          s1         s2          s3          s4
## s1 0.960545 0.02342267 0.009019082 0.007013239
## s2 0.000000 0.92265231 0.009019082 0.071514772
```

```
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 10, f_60
##
##          s1         s2          s3          s4
## s1 0.960545 0.02341108 0.009019082 0.007024834
## s2 0.000000 0.92215816 0.009019082 0.072008918
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 1, f_65
##
##          s1         s2          s3          s4
## s1 0.960545 0.02339004 0.009019082 0.007045876
## s2 0.000000 0.91807523 0.009019082 0.072905693
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 2, f_65
##
##          s1         s2          s3          s4
## s1 0.960545 0.02341973 0.009019082 0.007016189
## s2 0.000000 0.91934043 0.009019082 0.071640488
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 3, f_65
##
##          s1        s2          s3          s4
## s1 0.960545 0.0234204 0.009019082 0.007015516
## s2 0.000000 0.9193691 0.009019082 0.071611821
## s3 0.000000 0.0000000 1.000000000 0.000000000
## s4 0.000000 0.0000000 0.000000000 1.000000000
##
## , , 4, f_65
##
##          s1        s2          s3          s4
## s1 0.960545 0.0234390 0.009019082 0.006996917
## s2 0.000000 0.9201618 0.009019082 0.070819146
## s3 0.000000 0.0000000 1.000000000 0.000000000
## s4 0.000000 0.0000000 0.000000000 1.000000000
##
## , , 5, f_65
##
##          s1         s2          s3          s4
## s1 0.960545 0.02340422 0.009019082 0.007031697
## s2 0.000000 0.91867952 0.009019082 0.072301403
## s3 0.000000 0.00000000 1.000000000 0.000000000
## s4 0.000000 0.00000000 0.000000000 1.000000000
##
## , , 6, f_65
##
##           s1        s2         s3         s4
```

```
## s1 0.9385563 0.0332539 0.01479644 0.01339335
## s2 0.0000000 0.8912902 0.01479644 0.09969071
## s3 0.0000000 0.0000000 1.00000000 0.00000000
## s4 0.0000000 0.0000000 0.00000000 1.00000000
##
## , , 7, f_65
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03324701 0.01479644 0.01340024
## s2 0.0000000 0.89108349 0.01479644 0.09989743
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 8, f_65
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03328354 0.01479644 0.01336370
## s2 0.0000000 0.89217939 0.01479644 0.09880153
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 9, f_65
##
##           s1        s2         s3         s4
## s1 0.9385563 0.0332810 0.01479644 0.01336624
## s2 0.0000000 0.8921032 0.01479644 0.09887774
## s3 0.0000000 0.0000000 1.00000000 0.00000000
## s4 0.0000000 0.0000000 0.00000000 1.00000000
##
## , , 10, f_65
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03323683 0.01479644 0.01341041
## s2 0.0000000 0.89077834 0.01479644 0.10020258
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 1, f_70
##
##           s1         s2         s3        s4
## s1 0.9385563 0.03323934 0.01479644 0.0134079
## s2 0.0000000 0.88507620 0.01479644 0.1001274
## s3 0.0000000 0.00000000 1.00000000 0.0000000
## s4 0.0000000 0.00000000 0.00000000 1.0000000
##
## , , 2, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03329924 0.01479644 0.01334800
## s2 0.0000000 0.88687298 0.01479644 0.09833058
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 3, f_70
```

```
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03330424 0.01479644 0.01334301
## s2 0.0000000 0.88702286 0.01479644 0.09818070
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 4, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03323117 0.01479644 0.01341608
## s2 0.0000000 0.88483104 0.01479644 0.10037252
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 5, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03319677 0.01479644 0.01345047
## s2 0.0000000 0.88379940 0.01479644 0.10140415
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 6, f_70
##
##           s1         s2         s3        s4
## s1 0.9385563 0.03323655 0.01479644 0.0134107
## s2 0.0000000 0.88499239 0.01479644 0.1002112
## s3 0.0000000 0.00000000 1.00000000 0.0000000
## s4 0.0000000 0.00000000 0.00000000 1.0000000
##
## , , 7, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03324102 0.01479644 0.01340622
## s2 0.0000000 0.88512663 0.01479644 0.10007693
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 8, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03324522 0.01479644 0.01340203
## s2 0.0000000 0.88525250 0.01479644 0.09995106
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
##
## , , 9, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03318998 0.01479644 0.01345727
## s2 0.0000000 0.88359555 0.01479644 0.10160801
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
```

```
##
## , , 10, f_70
##
##           s1         s2         s3         s4
## s1 0.9385563 0.03324743 0.01479644 0.01339981
## s2 0.0000000 0.88531886 0.01479644 0.09988470
## s3 0.0000000 0.00000000 1.00000000 0.00000000
## s4 0.0000000 0.00000000 0.00000000 1.00000000
```

```
### Calculations
### 1. the population
population<-matrix(c(40,45,50,55,60,65,70,
                     40,45,50,55,60,65,70,
                     229,444,422,410,322,160,116,
                     498,856,822,842,519,394,187,
                     1,1,1,1,1,1,1,2,2,2,2,2,2,2),
                   ncol=3,nrow=14,
                   dimnames=list(1:14,c("age","num","sex")),byrow=F)
population  ##sex:1-male 2-female
```

```
##    age num sex
## 1   40 229   1
## 2   45 444   1
## 3   50 422   1
## 4   55 410   1
## 5   60 322   1
## 6   65 160   1
## 7   70 116   1
## 8   40 498   2
## 9   45 856   2
## 10  50 822   2
## 11  55 842   2
## 12  60 519   2
## 13  65 394   2
## 14  70 187   2
```

```
### 2.initial state
s_start <- matrix(NA,nrow=14,ncol=4,
                  dimnames=list(1:14,names_state))
s_start[,1]<-population[1:14,2]
s_start[,2]<-0
s_start[,3]<-0
s_start[,4]<-0
s_start
```

```
##     s1 s2 s3 s4
## 1  229  0  0  0
## 2  444  0  0  0
## 3  422  0  0  0
## 4  410  0  0  0
## 5  322  0  0  0
## 6  160  0  0  0
## 7  116  0  0  0
```

```
## 8  498  0  0  0
## 9  856  0  0  0
## 10 822  0  0  0
## 11 842  0  0  0
## 12 519  0  0  0
## 13 394  0  0  0
## 14 187  0  0  0
```

```
m_M<-array(NA,dim=c(10,4,14),
           dimnames=list(1:10,names_state,names_population))
for (i in 1:14) {
  m_M[1,,i]<-s_start[i,]
}
m_M
```

```
## , , m_40
##
##     s1 s2 s3 s4
## 1  229  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , m_45
##
##     s1 s2 s3 s4
## 1  444  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , m_50
##
##     s1 s2 s3 s4
## 1  422  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
```

```
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , m_55
##
##     s1 s2 s3 s4
## 1  410  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , m_60
##
##     s1 s2 s3 s4
## 1  322  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , m_65
##
##     s1 s2 s3 s4
## 1  160  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , m_70
##
##     s1 s2 s3 s4
## 1  116  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
```

```
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_40
##
##     s1 s2 s3 s4
## 1  498  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_45
##
##     s1 s2 s3 s4
## 1  856  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_50
##
##     s1 s2 s3 s4
## 1  822  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_55
##
##     s1 s2 s3 s4
## 1  842  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
```

```
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_60
##
##     s1 s2 s3 s4
## 1  519  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_65
##
##     s1 s2 s3 s4
## 1  394  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
##
## , , f_70
##
##     s1 s2 s3 s4
## 1  187  0  0  0
## 2   NA NA NA NA
## 3   NA NA NA NA
## 4   NA NA NA NA
## 5   NA NA NA NA
## 6   NA NA NA NA
## 7   NA NA NA NA
## 8   NA NA NA NA
## 9   NA NA NA NA
## 10  NA NA NA NA
```

```
###3) sates of 10 cycles
uti <- c(1,0.9,0,0)  # utility values
uti2 <- -0.038  ## TODO: how to get
year <- c(1,1,0,0)
n_cnew <- array(0,
```

```
                dim=c(10,1,14),
                dimnames=list(1:10,"num",names_population))  ## new events of CVD
n_clive <- array(0,
                 dim=c(10,1,14),
                 dimnames=list(1:10,"num",names_population))

n_cvd <- 0
n_cd <- 0
n_nd <- 0
n_d <- 0
qaly <- 0
qaly_m <- array(0,
                dim=c(10,4,14),
                dimnames=list(1:10,names_state,names_population))
for (i in 1:14){
  qaly_m[1,,i]<-m_M[1,,i] * uti  ## the 1st year qaly
}
lifeyear<-0
lifeyear_m<-array(0,
                  dim=c(10,4,14),
                  dimnames=list(1:10,names_state,names_population))
for (i in 1:14){
  lifeyear_m[1,,i]<-m_M[1,,i]*year
}
qaly_m
```

```
## , , m_40
##
##     s1 s2 s3 s4
## 1  229  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_45
##
##     s1 s2 s3 s4
## 1  444  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
```

```
##
## , , m_50
##
##     s1 s2 s3 s4
## 1  422  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_55
##
##     s1 s2 s3 s4
## 1  410  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_60
##
##     s1 s2 s3 s4
## 1  322  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_65
##
##     s1 s2 s3 s4
## 1  160  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
```

```
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_70
##
##     s1 s2 s3 s4
## 1  116  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_40
##
##     s1 s2 s3 s4
## 1  498  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_45
##
##     s1 s2 s3 s4
## 1  856  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_50
##
##     s1 s2 s3 s4
## 1  822  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
```

```
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_55
##
##     s1 s2 s3 s4
## 1  842  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_60
##
##     s1 s2 s3 s4
## 1  519  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_65
##
##     s1 s2 s3 s4
## 1  394  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_70
##
##     s1 s2 s3 s4
## 1  187  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
```

```
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
```

```
lifeyear_m
```

```
## , , m_40
##
##     s1 s2 s3 s4
## 1  229  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_45
##
##     s1 s2 s3 s4
## 1  444  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_50
##
##     s1 s2 s3 s4
## 1  422  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_55
##
##     s1 s2 s3 s4
```

```
## 1  410  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_60
##
##     s1 s2 s3 s4
## 1  322  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_65
##
##     s1 s2 s3 s4
## 1  160  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , m_70
##
##     s1 s2 s3 s4
## 1  116  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_40
```

```
##
##     s1 s2 s3 s4
## 1  498  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_45
##
##     s1 s2 s3 s4
## 1  856  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_50
##
##     s1 s2 s3 s4
## 1  822  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_55
##
##     s1 s2 s3 s4
## 1  842  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
```

```
##
## , , f_60
##
##     s1 s2 s3 s4
## 1  519  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_65
##
##     s1 s2 s3 s4
## 1  394  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
##
## , , f_70
##
##     s1 s2 s3 s4
## 1  187  0  0  0
## 2    0  0  0  0
## 3    0  0  0  0
## 4    0  0  0  0
## 5    0  0  0  0
## 6    0  0  0  0
## 7    0  0  0  0
## 8    0  0  0  0
## 9    0  0  0  0
## 10   0  0  0  0
```

```r
#### addtional transition probability
#### probability of recurring CVD

p9 <- array(NA,
            dim=c(10,n_population),
            dimnames=list(1:10,names_population))
for (i in 1:14){
  if (i==7 | i==14){
    for (j in 1:10)
      p9[j,i]<-p7[i]*(1-p8[j,i])
  }
```

```
  else {
    for (j in 1:5){
      p9[j,i]<-p7[i]*(1-p8[j,i])
    }
    for (j in 6:10){
      p9[j,i]<-p7[i+1]*p8[j,i]
    }
  }
}
p9
```

```
##            m_40         m_45         m_50         m_55         m_60        m_65
## 1  0.0050896665 0.0088307191 0.0129815809 0.0194624896 0.0271331668 0.038919928
## 2  0.0050443883 0.0088522883 0.0138105480 0.0192681847 0.0275459814 0.037651766
## 3  0.0049591409 0.0084780129 0.0133062915 0.0194435344 0.0272234129 0.039050591
## 4  0.0048167200 0.0087001142 0.0139098862 0.0199518047 0.0277691990 0.039689648
## 5  0.0051167729 0.0084172901 0.0137473590 0.0188914230 0.0278245541 0.040265289
## 6  0.0008420031 0.0008578052 0.0010520435 0.0021804877 0.0034361505 0.001608279
## 7  0.0008759398 0.0011101097 0.0004356107 0.0024790796 0.0009036431 0.002606041
## 8  0.0006677999 0.0014247887 0.0010458810 0.0008497767 0.0024042497 0.003537334
## 9  0.0006445693 0.0007228139 0.0018518117 0.0023116403 0.0032475658 0.004197141
## 10 0.0002286027 0.0011787464 0.0009763545 0.0015698998 0.0031167057 0.003022800
##           m_70         f_40         f_45         f_50         f_55         f_60
## 1  0.05217461 0.0059098354 0.0091300685 0.0132217665 0.0172473946 0.0222232043
## 2  0.05502457 0.0056615685 0.0089153615 0.0134206869 0.0176959004 0.0227049276
## 3  0.05426309 0.0059060592 0.0091568553 0.0127784945 0.0178192653 0.0234442646
## 4  0.05484605 0.0059124641 0.0092145336 0.0125209137 0.0167446958 0.0232969222
## 5  0.05338039 0.0058417221 0.0088809190 0.0126280876 0.0172789741 0.0238552943
## 6  0.05518834 0.0008826110 0.0004983519 0.0015578196 0.0009130854 0.0006707309
## 7  0.05417345 0.0008610836 0.0010580623 0.0010490606 0.0007478266 0.0024617645
## 8  0.05284912 0.0004945391 0.0004091817 0.0009818421 0.0014352812 0.0009004629
## 9  0.05598805 0.0007938416 0.0005454647 0.0015779916 0.0023143597 0.0017752158
## 10 0.05234744 0.0009354809 0.0004329740 0.0012716706 0.0016730951 0.0022693622
##           f_65       f_70
## 1  0.028703310 0.04214006
## 2  0.029968514 0.04393684
## 3  0.029997182 0.04408672
## 4  0.030789857 0.04189490
## 5  0.029307600 0.04086327
## 6  0.002540632 0.04205625
## 7  0.002747357 0.04219049
## 8  0.001651458 0.04231636
## 9  0.001727663 0.04065941
## 10 0.003052503 0.04238272
```

```
############################################################

#### addtional transition probability
#### probability of first time CVD
p10 <- array(NA,
             dim=c(10,n_population),
             dimnames=list(1:10,names_population))
for (i in 1:14){
```

```
  if (i==7 | i==14){
    for (j in 1:10)
      p10[j,i]<-p1_0[i]
  }
  else {
    for (j in 1:5){
      p10[j,i]<-p1_0[i]
    }
    for (j in 6:10){
      p10[j,i]<-p1_0[i+1]
    }
  }
}
p10
```

```
##           m_40        m_45       m_50       m_55       m_60       m_65
## 1  0.003880452 0.006706411 0.01050840 0.01517469 0.02183606 0.03050504
## 2  0.003880452 0.006706411 0.01050840 0.01517469 0.02183606 0.03050504
## 3  0.003880452 0.006706411 0.01050840 0.01517469 0.02183606 0.03050504
## 4  0.003880452 0.006706411 0.01050840 0.01517469 0.02183606 0.03050504
## 5  0.003880452 0.006706411 0.01050840 0.01517469 0.02183606 0.03050504
## 6  0.006706411 0.010508397 0.01517469 0.02183606 0.03050504 0.04265265
## 7  0.006706411 0.010508397 0.01517469 0.02183606 0.03050504 0.04265265
## 8  0.006706411 0.010508397 0.01517469 0.02183606 0.03050504 0.04265265
## 9  0.006706411 0.010508397 0.01517469 0.02183606 0.03050504 0.04265265
## 10 0.006706411 0.010508397 0.01517469 0.02183606 0.03050504 0.04265265
##           m_70        f_40        f_45       f_50       f_55       f_60
## 1  0.04265265 0.004534687 0.007068897 0.01008183 0.01364012 0.01810608
## 2  0.04265265 0.004534687 0.007068897 0.01008183 0.01364012 0.01810608
## 3  0.04265265 0.004534687 0.007068897 0.01008183 0.01364012 0.01810608
## 4  0.04265265 0.004534687 0.007068897 0.01008183 0.01364012 0.01810608
## 5  0.04265265 0.004534687 0.007068897 0.01008183 0.01364012 0.01810608
## 6  0.04265265 0.007068897 0.010081834 0.01364012 0.01810608 0.02346433
## 7  0.04265265 0.007068897 0.010081834 0.01364012 0.01810608 0.02346433
## 8  0.04265265 0.007068897 0.010081834 0.01364012 0.01810608 0.02346433
## 9  0.04265265 0.007068897 0.010081834 0.01364012 0.01810608 0.02346433
## 10 0.04265265 0.007068897 0.010081834 0.01364012 0.01810608 0.02346433
##           f_65      f_70
## 1  0.02346433 0.0333386
## 2  0.02346433 0.0333386
## 3  0.02346433 0.0333386
## 4  0.02346433 0.0333386
## 5  0.02346433 0.0333386
## 6  0.03333860 0.0333386
## 7  0.03333860 0.0333386
## 8  0.03333860 0.0333386
## 9  0.03333860 0.0333386
## 10 0.03333860 0.0333386
```

```
#####################################################


for (i in 1:14){
```

```
  for (j in 1:9){
    m_M[j+1,,i]<-m_M[j,,i] %*% a_P[,,j,i]
    n_cnew[j+1,1,i]<-m_M[j,1,i] * p10[j,i]   ## new occurence = S1*p9
    n_clive[j+1,1,i]<-m_M[j,1,i]*a_P["s1","s2",j,i] +m_M[j,2,i]*p9[j,i]
    ## new/recur cvd = S1*p1 + S2*p9
    qaly_m[j+1,,i]<-m_M[j+1,,i] * uti+n_clive[j+1,1,i]*uti2
    ## qaly = qaly (under 4 states) + the lose of qaly
    lifeyear_m[j+1,,i]<-m_M[j+1,,i]*year
  }
  n_cvd[i]<-sum(n_cnew[1:10,,i])
  n_cd[i]<-m_M[10,4,i]
  n_nd[i]<- m_M[10,3,i]
  n_d[i]<-n_cd[i]+n_nd[i]
  qaly[i]<-sum(qaly_m[1:10,,i])
  lifeyear[i]<-sum(lifeyear_m[1:10,,i])
}
# n_cnew
```

```
# m_M
# n_cnew  ## new events of CVD
# n_clive
#
#
# n_cvd
# n_cd
# n_nd
# n_d
# qaly
# lifeyear
#
N_cvd<-sum(n_cvd)
N_cd<-sum(n_cd)
N_nd<-sum(n_nd)
N_d<-sum(n_d)
QALY<-sum(qaly)
LIFEYEAR<-sum(lifeyear)
#
N_cvd
```

```
## [1] 764.0602
```

```
# N_cd
# N_nd
# N_d
# QALY
# LIFEYEAR
```