stg0_Jiamin

```
library(knitr)
library(xtable)
library(darthtools)
library(ggplot2)
library(readr)
set.seed(1)
source("function/transform_func.R")
rate_data <- read_csv("data/ghdx_data.csv")
population_data <- read_csv("data/Normal3Stra_data.csv")
population_data <- data.frame(population_data)
```

```
p_live_cvd <- rate_to_prob(rate_data$incidence,1)
p_live_cvdth <- rate_to_prob(rate_data$death_CVD,1)
p_live_oth_death <- rate_to_prob(rate_data$death_nonCVD,1)

p_ccvd_cvdth <- rate_to_prob(p_live_cvdth,3.12)
p_ccvd_acvd <- rate_to_prob(p_live_cvd,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))
p2<-array(0,dim=c(10,n_population),dimnames=list(1:10,names_population))
p4<-array(0,dim=c(10,n_population),dimnames=list(1:10,names_population))
set.seed(1)
p8<-array(runif(140,min=0.02,max=0.1),dim=c(10,n_population),dimnames=list(1:10,names_population))
p5<-array(0,dim=c(10,n_population),dimnames=list(1:10,names_population))
p6<-array(0,dim=c(10,n_population),dimnames=list(1:10,names_population))

for (i in 1:14){
  if (i==7 | i==14){
    a_P["s1","s3",1:10,i]<-p_live_oth_death[i]
    a_P["s2","s3",1:10,i]<-p_live_oth_death[i]
    for ( j in 1:10){
      p2[j,i]<-p_live_cvdth[i]+p_live_cvd[i]*p8[j,i]
      p1[j,i]<-p_live_cvd[i]*(1-p8[j,i])
      p4[j,i]<-1-p1[j,i]-p2[j,i]-p_live_oth_death[i]
      p5[j,i]<-p_ccvd_cvdth[i]+p_ccvd_acvd[i]*p8[j,i]
      p6[j,i]<-1-p5[j,i]-p_live_oth_death[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{
    a_P["s1","s3",1:5,i]<-p_live_oth_death[i]
    a_P["s2","s3",1:5,i]<-p_live_oth_death[i]
    for ( j in 1:5){
      p2[j,i]<-p_live_cvdth[i]+p_live_cvd[i]*p8[j,i]
      p1[j,i]<-p_live_cvd[i]*(1-p8[j,i])
      p4[j,i]<-1-p1[j,i]-p2[j,i]-p_live_oth_death[i]
      p5[j,i]<-p_ccvd_cvdth[i]+p_ccvd_acvd[i]*p8[j,i]
      p6[j,i]<-1-p5[j,i]-p_live_oth_death[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

    a_P["s1","s3",6:10,i]<-p_live_oth_death[i+1]
    a_P["s2","s3",6:10,i]<-p_live_oth_death[i+1]
    for ( j in 6:10){
      p2[j,i]<-p_live_cvdth[i+1]+p_live_cvd[i+1]*p8[j,i]
      p1[j,i]<-p_live_cvd[i+1]*(1-p8[j,i])
      p4[j,i]<-1-p1[j,i]-p2[j,i]-p_live_oth_death[i+1]
      p5[j,i]<-p_ccvd_cvdth[i+1]+p_ccvd_acvd[i+1]*p8[j,i]
      p6[j,i]<-1-p5[j,i]-p_live_oth_death[i+1]
      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
  }
}
```

```r
a_P[ , ,1, 1] # m40 1st year
```

```
##         s1          s2          s3           s4
## s1 0.99281 0.003720419 0.002490893 0.0009786972
## s2 0.00000 0.994739470 0.002490893 0.0027696374
## s3 0.00000 0.000000000 1.000000000 0.0000000000
## s4 0.00000 0.000000000 0.000000000 1.0000000000
```

```r
a_P[ , ,1, 5] # m40 5st year
```

```
##           s1         s2         s3          s4
## s1 0.9606834 0.01996524 0.01109697 0.008254358
## s2 0.0000000 0.96665835 0.01109697 0.022244679
## s3 0.0000000 0.00000000 1.00000000 0.000000000
## s4 0.0000000 0.00000000 0.00000000 1.000000000
```

```r
a_P[ , ,1, 10] # m40 10st year
```

```
##          s1          s2         s3          s4
## s1 0.986241 0.009686925 0.00247194 0.001600182
## s2 0.000000 0.993237364 0.00247194 0.004290696
## s3 0.000000 0.000000000 1.00000000 0.000000000
## s4 0.000000 0.000000000 0.00000000 1.000000000
```

```r
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)
```

```r
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
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
uti<-c(1,0.9,0,0)
uti2 <- -0.038
year<-c(1,1,0,0)
n_cnew<-array(0,dim=c(10,1,14),dimnames=list(1:10,"num",names_population))
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
}
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
}
```

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

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]<-p_live_cvd[i]
  }
  else {
    for (j in 1:5){
      p10[j,i]<-p_live_cvd[i]
    }
    for (j in 6:10){
      p10[j,i]<-p_live_cvd[i+1]
    }
  }
}
```

```
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]
    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]
    qaly_m[j+1,,i]<-m_M[j+1,,i] * uti+n_clive[j+1,1,i]*uti2
    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])
}
m_M[, , 1]
```

```
##          s1       s2        s3        s4
## 1  229.0000 0.000000 0.0000000 0.0000000
## 2  227.3535 0.851976 0.5704144 0.2241217
## 3  225.7188 1.685781 1.1388497 0.4565549
## 4  224.0959 2.494926 1.7052901 0.7038900
## 5  222.4846 3.270141 2.2697035 0.9755132
## 6  220.8850 4.085171 2.8320344 1.1978185
## 7  218.3583 5.396097 3.5954098 1.6501638
## 8  215.8606 6.675014 4.3546601 2.1097412
## 9  213.3914 7.962254 5.1097745 2.5365602
## 10 210.9505 9.227362 5.8608784 2.9612789
```

```
print(xtable(data.frame(n_cvd,row.names = names_population)))
```

% latex table generated in R 3.6.3 by xtable 1.8-4 package % Sun Jan 31 19:05:32 2021

	n_cvd
m_40	10.20
m_45	31.71
m_50	43.92
m_55	59.10
m_60	61.94
m_65	39.40
m_70	31.64
f_40	24.63
f_45	61.96
f_50	80.96
f_55	108.29
f_60	84.31
f_65	81.88
f_70	44.12

```
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)
print(xtable(data.frame(N_cvd,N_cd,N_nd,N_d, QALY, LIFEYEAR),
      caption = "Distribution of the population"),
      caption.placement="top",comment=FALSE)
```

Table 1: Distribution of the population

	N_cvd	N_cd	N_nd	N_d	QALY	LIFEYEAR
1	764.06	295.31	326.88	622.19	58905.31	59349.86