Microsimulation Sick-Sicker model

Includes individual characteristics: age, age dependent mortality probabilities, individual treatment effect modifyer

The DARTH workgroup

Developed by the Decision Analysis in R for Technologies in Health (DARTH) workgroup:

Fernando Alarid-Escudero, PhD (1)

Eva A. Enns, MS, PhD (2)

M.G. Myriam Hunink, MD, PhD (3,4)

Hawre J. Jalal, MD, PhD (5)

Eline M. Krijkamp, MSc (3)

Petros Pechlivanoglou, PhD (6,7)

Alan Yang, MSc (7)

In collaboration of:

1. Drug Policy Program, Center for Research and Teaching in Economics (CIDE) - CONACyT, Aguascalientes, Mexico
2. University of Minnesota School of Public Health, Minneapolis, MN, USA
3. Erasmus MC, Rotterdam, The Netherlands
4. Harvard T.H. Chan School of Public Health, Boston, USA
5. University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA, USA
6. University of Toronto, Toronto ON, Canada
7. The Hospital for Sick Children, Toronto ON, Canada

Please cite our publications when using this code:

- Jalal H, Pechlivanoglou P, Krijkamp E, Alarid-Escudero F, Enns E, Hunink MG. An Overview of R in Health Decision Sciences. Med Decis Making. 2017; 37(3): 735-746. https://journals.sagepub.com/doi/abs/10.1177/0272989X16686559
- Krijkamp EM, Alarid-Escudero F, Enns EA, Jalal HJ, Hunink MGM, Pechlivanoglou P. Microsimulation modeling for health decision sciences using R: A tutorial. Med Decis Making. 2018;38(3):400–22. https://journals.sagepub.com/doi/abs/10.1177/0272989X18754513
- Krijkamp EM, Alarid-Escudero F, Enns E, Pechlivanoglou P, Hunink MM, Jalal H. A Multidimensional Array Representation of State-Transition Model Dynamics. Med Decis Making. 2020 Online first. https://doi.org/10.1177/0272989X19893973

Change `eval` to `TRUE` if you want to knit this document.

```
rm(list = ls())      # clear memory (removes all the variables from the workspace)
```

01 Load packages

```
if (!require('pacman')) install.packages('pacman'); library(pacman) # use this package to conveniently
 # load (install if required) packages from CRAN
 p_load("here", "dplyr", "devtools", "scales", "ellipse", "ggplot2", "lazyeval", "igraph", "ggraph", "r
 # load (install if required) packages from GitHub
# install_github("DARTH-git/dampack", force = TRUE) # Uncomment if there is a newer version
# install_github("DARTH-git/darthtools", force = TRUE) # Uncomment if there is a newer version
p_load_gh("DARTH-git/darthtools")
```

02 Load functions

```
# No functions needed
```

03 Input model parameters

```
set.seed(1)  # set the seed

# Model structure
n_t   <- 30                       # time horizon, 30 cycles
n_i   <- 100000                   # number of simulated individuals
v_names_states  <- c("H", "S1", "S2", "D")  # the model states names
n_states   <- length(v_names_states)        # the number of health states
d_r   <- 0.03                     # discount rate of 3% per cycle
v_dwe <- v_dwc <- 1 / ((1 + d_r) ^ (0:n_t))    # discount weight
v_names_str <- c("no treatment", "treatment")  # strategy names
n_str <- length(v_names_str)      # number of strategies

### Event probabilities (per cycle)
# Annual transition probabilities
p_HS1   <- 0.15                   # probability of becoming sick when healthy
p_S1H   <- 0.5                    # probability of recovering to healthy when sick
p_S1S2  <- 0.105                  # probability of becoming sicker when sick

# Annual probabilities of death
# load age dependent probability
p_mort   <- read.csv("mortProb_age.csv")
# load age distribution
dist_Age <- read.csv("MyPopulation-AgeDistribution.csv")

p_S1D    <- 0.0149          # probability to die in S1 by cycle
```

```r
p_S2D    <- 0.048           # probability to die in S2 by cycle

# Cost inputs
c_H     <- 2000             # cost of one cycle in the healthy state
c_S1    <- 4000             # cost of one cycle in the sick state
c_S2    <- 15000            # cost of one cycle in the sicker state
c_D     <- 0                # cost of one cycle in the dead state
c_Trt   <- 12000            # cost of treatment (per cycle)

# Utility inputs
u_H     <- 1                # utility when healthy
u_S1    <- 0.75             # utility when sick
u_S2    <- 0.5              # utility when sicker
u_D     <- 0                # utility when dead
u_Trt   <- 0.95             # utility when sick and being treated
```

04 Sample individual level characteristics

04.1 Static characteristics

```r
# your turn
```

04.2 Dynamic characteristics

```r
# your turn
```

05 Define Simulation Functions

05.1 Probability function

The function that updates the transition probabilities of every cycle is shown below.

```r
# your turn
```

05.2 Cost function

The `Costs` function estimates the costs at every cycle.

```r
# your turn
```

05.3 Health outcome function

The `Effs` function to update the utilities at every cycle.

```
# your turn
```

06 Run Microsimulation

```
# your turn
```

07 Visualize results

```
# your turn
```

08 Cost Effectiveness Analysis

```
# your turn
```