Microsimulation Sick-Sicker model with time dependency with PSA

Includes individual characteristics: age, age dependent mortality probabilities, individual treatment effect modifyer, time dependency for the sick (S1) state, increasing change of death in the first 6 year of sickness (tunnel)

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- 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

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

01 Load packages

```r
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
 p_load_gh("DARTH-git/dampack")
```

02 Load functions

```r
source(here("functions", "Functions.R"))
```

03 Input model parameters

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

# Model structure
n_t   <- 30                       # time horizon, 30 cycles
n_i   <- 100000                   # number of simulated individuals
v_n   <- c("H", "S1", "S2", "D")  # the model states names
n_s   <- length(v_n)              # 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(here("data", "mortProb_age.csv"))
# load age distribution
dist_Age <- read.csv(here("data", "MyPopulation-AgeDistribution.csv"))

# probability to die in S1 by cycle
p_S1D    <- c(0.0149, 0.018, 0.021, 0.026, 0.031, rep(0.037, n_t - 5))
p_S2D    <- 0.048           # probability to die in S2

# 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
```

```r
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(er) 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.

```r
# your turn
```

06 Run Microsimulation

```r
# your turn
```

07 Visualize results

```r
# your turn
```

08 Cost Effectiveness Analysis

```
# your turn
```

09 Probabilistic Sensitivity Analysis (PSA)

```
# your turn
```

09.1 Load function of microsimulation model

```
# your turn
```

09.2 Run microsimulation model on each parameter set of PSA input dataset

```
# your turn
```

09.3 Cost Effectiveness Analysis

Vector with willingness-to-pay (WTP) thresholds

```
# your turn
```

09.3.1 ICER

```
# your turn
```

09.3.2 Cost-Effectiveness Acceptability Curves (CEAC) and Frontier (CEAF)

```
# your turn
```

09.3.3 Cost-Effectiveness Scatter plot

```
# your turn
```

09.3.4 Expected Value of Perfect Information (EVPI)

```
# your turn
```