PSA: Three-strategy decision tree in R - HVE

The DARTH workgroup

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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", "truncnorm",
# load (install if required) packages from GitHub
# install_github("DARTH-git/dectree", force = TRUE) # Uncomment if there is a newer version
p_load_gh("DARTH-git/dectree") # load one or more GitHub packages
```

02 Load functions

```
source(here('functions','Functions.R'))
```

03 Define parameter input values

```
v_names_str   <- c("No Tx", "Tx All", "Biopsy")    # names of strategies
n_str         <- length(v_names_str)               # number of strategies
wtp           <- 100000                            # willingness to pay threshold

# Probabilities
p_HVE         <- 0.52   # prevalence of HVE
p_HVE_comp    <- 0.71   # complications with untreated HVE
p_OVE_comp    <- 0.01   # complications with untreated OVE
p_HVE_comp_tx <- 0.36   # complications with treated HVE
p_OVE_comp_tx <- 0.20   # complications with treated OVE
p_biopsy_comp <- 0.05   # probability of complications due to biopsy

# Costs
c_VE          <- 1200   # cost of viral encephalitis care without complications
c_VE_comp     <- 9000   # cost of viral encephalitis care with complications
c_tx          <- 9500   # cost of treatment
c_biopsy      <- 25000  # cost of brain biopsy

# QALYs
q_VE          <- 20     # remaining QALYs for those without VE-related complications
q_VE_comp     <- 19     # remaining QALYs for those with VE-related complications
q_loss_biopsy <- -0.01  # one-time QALY loss due to brain biopsy

# store the parameters into a list
l_params_all <- as.list(data.frame(p_HVE, p_HVE_comp, p_OVE_comp, p_HVE_comp_tx, p_OVE_comp_tx, p_biopsy
                                   c_VE, c_VE_comp, c_tx, c_biopsy,
```

```
                                    q_VE, q_VE_comp, q_loss_biopsy))
# store the names of the parameters into a vector
v_names_params <- c('p_HVE', 'p_HVE_comp', 'p_OVE_comp', 'p_HVE_comp_tx', 'p_OVE_comp_tx', 'p_biopsy_co
                    'c_VE', 'c_VE_comp',  'c_tx', 'c_biopsy', 'q_VE', 'q_VE_comp', 'q_loss_biopsy')
```

04 Create and run decision tree model

```
decision_tree_HVE_output <- with(as.list(l_params_all), {

  # Create vector of weights for each strategy

  v_w_no_tx  <- c(  p_HVE  *    p_HVE_comp  ,  # HVE, complications
                    p_HVE  * (1-p_HVE_comp) ,  # HVE, no complications
                  (1-p_HVE) *    p_OVE_comp  ,  # OVE, complications
                  (1-p_HVE) * (1-p_OVE_comp))   # OVE, no complications

  v_w_tx     <- # your turn

  v_w_biopsy <- # your turn

  # Create vector of outcomes (QALYs) for each strategy

  v_qaly_no_tx  <- c(q_VE_comp ,  # HVE, complications
                     q_VE      ,  # HVE, no complications
                     q_VE_comp ,  # OVE, complications
                     q_VE)        # OVE, no complications

  v_qaly_tx     <- # your turn

  v_qaly_biopsy <- # your turn

  # Create vector of costs for each strategy

  v_cost_no_tx  <- c(c_VE_comp ,  # HVE, complications
                     c_VE      ,  # HVE, no complications
                     c_VE_comp ,  # OVE, complications
                     c_VE)        # OVE, no complications

  v_costs_tx     <- # your turn

  v_costs_biopsy <- # your turn

  # Calculate total utilities for each strategy ####
  total_qaly_no_tx  <- v_w_no_tx  %*%  v_qaly_no_tx
  total_qaly_tx     <- v_w_tx     %*%  v_qaly_tx
  total_qaly_biopsy <- v_w_biopsy %*%  v_qaly_biopsy

  # Calculate total costs for each strategy ####
  total_cost_no_tx  <- v_w_no_tx  %*%  v_cost_no_tx
  total_cost_tx     <- v_w_tx     %*%  v_cost_tx
  total_cost_biopsy <- v_w_biopsy %*%  v_cost_biopsy
```

```
  v_total_qaly <- c(total_qaly_no_tx, total_qaly_tx, total_qaly_biopsy)  # vector of total QALYs
  v_total_cost <- c(total_cost_no_tx, total_cost_tx, total_cost_biopsy)  # vector of total costs
  v_nmb        <- v_total_qaly * wtp - v_total_cost                      # calculate vector of nmb

  # Name outcomes
  names(v_total_qaly) <- v_names_str  # names for the elements of the total QALYs vector
  names(v_total_cost) <- v_names_str  # names for the elements of the total cost vector
  names(v_nmb)        <- v_names_str  # names for the elements of the nmb vector

  df_output <- data.frame(Strategy =  v_names_str,
                          Cost     =  v_total_cost,
                          Effect   =  v_total_qaly,
                          NMB      =  v_nmb)
  return(df_output)
})

# model output
decision_tree_HVE_output
```

04.1 Plot the decision tree

```
# your turn
```

05 Cost-Effectiveness Analysis

```
# your turn
```

05.1 Plot frontier of Decision Tree

```
# your turn
```

06 Deterministic Sensitivity Analysis

06.1 List of input parameters

```
# your turn
```

06.2 Load decision tree model function

```
# your turn
```

06.3 One-way sensitivity analysis (OWSA)

```
# your turn
```

06.3.1 Plot OWSA

```
# your turn
```

06.3.2 Optimal strategy with OWSA

```
# your turn
```

06.3.3 Tornado plot

```
# your turn
```

06.4 Two-way sensitivity analysis (TWSA)

```
# your turn
```

06.4.1 Plot TWSA

```
# your turn
```

07 Probabilistic Sensitivity Analysis (PSA)

```
# your turn
```

07.2 Create PSA object for dampack

```
# your turn
```

07.2.1 Save PSA objects

```
# your turn
```

07.3 Create probabilistic analysis graphs

```
# your turn
```

Vector with willingness-to-pay (WTP) thresholds.

```
# your turn
```

07.3.1 Cost-Effectiveness Scatter plot

```
# your turn
```

07.4 Conduct CEA with probabilistic output

```
# your turn
```

07.4.1 Plot cost-effectiveness frontier

```
# your turn
```

07.4.2 Cost-effectiveness acceptability curves (CEACs) and frontier (CEAF)

```
# your turn
```

07.4.3 Expected Loss Curves (ELCs)

```
# your turn
```

07.4.4 Expected value of perfect information (EVPI)

```
# your turn
```