

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>

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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/dampack", force = TRUE) # Uncomment if there is a newer version
# install_github("DARTH-git/dectree", force = TRUE) # Uncomment if there is a newer version
p_load_gh("DARTH-git/dampack", "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_biops
```

```

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_comp',
                    '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
```