Decision Modeling in R workshop

Decision Tree Exercise

The DARTH workgroup

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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

Exercise I: Treatment for Viral encephalitis – A Decision Tree

Viral encephalitis can be caused by herpes viruses (HVE) or other viruses (OVE). Herpes viruses cause approximately 52% of cases of viral encephalitis. Without treatment, the risk of complications (severe sequelae) for HVE is 71%; for OVE, the risk is only 1%. A drug, vidarabine, decreases the likelihood of complications due to HVE from 71% down to 36%. However, among OVE patients, treatment with vidarabine is associated with severe side effects, increasing the risk of complications from the 1% baseline to 20%. It is possible to obtain a definitive diagnosis of HVE by means of a brain biopsy, but the procedure itself also has a 0.5% probability of being fatal.

You are tasked with evaluating the healthcare costs and benefits associated with three possible management strategies (no treatment, vidarabine treatment, or brain biopsy followed by vidarabine treatment for those who are diagnosed with HVE). Benefits will be measured in terms of quality-adjusted life-years (QALYs).

The healthcare cost of a case of viral encephalitis without complications is $1,200; however, if complications occur, the cost rises to $9,000. The cost of vidarabine treatment is $9,500, while a brain biopsy is a $25,000 procedure.

A patient who recovers from viral encephalitis without complications has an average of 20 remaining QALYs; however, a patient who experiences complications has an average of 19 remaining QALYs. Since a brain biopsy is an unpleasant procedure, patients who undergo it also experience a one-time loss of 0.01 QALYs regardless of the outcome of the biopsy.

Parameters are summarized in Table 1. Use the code template provided in "decisition_tree_HVE_template.Rmd" as a starting point for this exercise.

Tasks

1. Sketch out the decision tree, with a particular focus on the outcome values (costs and QALYs) at terminal nodes.
2. The code template contains calculations for the "No Treatment" strategy. Write code that calculates the expected outcomes for the two other strategies.
3. Use the `calculate_icers()` function from the `dampack` package to calculate the incremental costs, QALYs, ICERs and Incremantal NMB of each strategy, using a willingness to pay of $100,000/QALY. Type "`?calculate_icers()`" to see function documentation.
4. Plot the cost-effectiveness frontier using the "`plot()`" function and the output from the "`calculate_icers()`" function (see step 3 above)

Table I: Input parameters

Parameter	R name	Value
Prevalence of HVE	`p_HVE`	0.52
Probability of complications without treatment		
- HVE	`p_HVE_comp`	0.71
- OVE	`p_OVE_comp`	0.01
Probability of complications with vidarabine treatment		
- HVE	`p_HVE_comp_tx`	0.36
- OVE	`p_OVE_comp_tx`	0.20
Probability of complications due to brain biopsy	`p_biopsy_death`	0.005
Quality-adjusted life-years (QALYs)		
- Remaining QALYs without VE complications	`q_VE`	20
- Remaining QALYs with VE complications	`q_VE_comp`	19
- QALY loss due to brain biopsy	`q_loss_biopsy`	0.01
Healthcare costs		
- Cost of viral encephalitis without complications	`c_VE`	$1,200

Parameter	R name	Value
- Cost of viral encephalitis with complications	`c_VE_comp`	$9,000
- Vidarabine treatment	`c_tx`	$9,500
- Brain biopsy	`c_biopsy`	$25,000
- Willingness-to-pay	`wtp`	$100,000/QALY