

Cohort tutorial

Appendix

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Cohort tutorial model components

Table I: Input parameters

This table contains an overview of the key model components used in the code for the Sick-Sicker example from the DARTH manuscript: “Implementation of cohort state-transition models in R”. The first column gives the mathematical notation for some of the model components that are used in the euqations in the manuscript. The second column gives a description of the model component with the R name in the third column. The forth gives the data structure, e.g. scalar, list, vector, matrix etc, with the according dimensions of this data structure in the fifth column. The final column indicated the type of data that is stored in the data structure, e.g. numeric (5.2,6.3,7.4), categoric (A,B,C), integer (5,6,7), logical (TRUE, FALSE).

Element	Description	R name	Data structure	Dimensions	Data type
n_t	Time horizon	<code>n_t</code>	scalar		numeric
v_s	Names of the health states	<code>v_n</code>	vector	<code>n_states</code> x 1	categorical
n_s	Number of health states	<code>n_states</code>	scalar		numeric
v_{str}	Names of the strategies	<code>v_names_str</code>	scalar		categorical
n_{str}	Number of strategies	<code>n_str</code>	scalar		numeric
d_c	Discount rate for costs	<code>d_c</code>	scalar		numeric
d_e	Discount rate for effects	<code>d_e</code>	scalar		numeric
	Discount weights for costs	<code>v_dwc</code>	vector	$(n_t \times 1) + 1$	numeric
	Discount weights for effects	<code>v_dwe</code>	vector	$(n_t \times 1) + 1$	numeric
v_{hcc}	half-cycle correction	<code>v_hcc</code>	vector	$(n_t \times 1) + 1$	numeric
age_0	Age at baseline	<code>n_age_init</code>	scalar		numeric
age	Maximum age of follow up	<code>n_age_max</code>	scalar		numeric
M	Cohort trace	<code>m_M</code>	matrix	$(n_t + 1) \times n_states$	numeric
m_0	Initial state vector	<code>v_s_init</code>	vector	$1 \times n_states$	numeric

Element	Description	R name	Data structure	Dimensions	Data type
Transition probabilities					
$p_{[H,S1]}$	From Healthy to Sick conditional on surviving	p_HS1	scalar		numeric
$p_{[S1,H]}$	From Sick to Healthy conditional on surviving	p_S1H	scalar		numeric
$p_{[S1,S2]}$	From Sick to Sicker conditional on surviving	p_S1S2	scalar		numeric
$p_{[H,D]}$	Annual all-cause mortality	p_HD	scalar		numeric
$hr_{[S1,H]}$	Hazard ratio of death in Sick vs Healthy	hr_S1	scalar		numeric
$hr_{[S2,H]}$	Hazard ratio of death in Sicker vs Healthy	hr_S2	scalar		numeric
$or_{[S1,S2]}$	Odds ratio of becoming Sicker when Sick under New treatment 2	or_S1S2	scalar		numeric
γ	Weibull parameters gamma	n_gamma	scalar		numeric
λ	Weibull parameters lambda	n_lambda	scalar		numeric
P	Transition probability matrix	m_P	matrix	n_states x n_states	numeric
$p_{[S1,S2,t]}$	Time dependent transition probability from sick to sicker	v_p_S1S2_tunnels	vector	n_t x 1	numeric
$r_{[H,D,t]}$	Age-specific background mortality rates	v_r_mort_by_age	vector	(n_age_max + 1) x 1	numeric
$p_{[H,D,t]}$	Age-specific mortality risk in the Healthy state	v_p_HDage	vector	n_t x 1	numeric
$p_{[S1,D,t]}$	Age-specific mortality risk in the Sick state	v_p_S1Dage	vector	n_t x 1	numeric
$p_{[S2,D,t]}$	Age-specific mortality risk in the Sicker state	v_p_S2Dage	vector	n_t x 1	numeric
Annual costs					
	Healthy individuals	c_H	scalar		numeric
	Sick individuals in the Sick state	c_S1	scalar		numeric
	Sick individuals in the Sicker state	c_S2	scalar		numeric
	Dead individuals	c_D	scalar		numeric
	Additional costs of New treatment 1	c_trt1	scalar		numeric
	Additional costs of New treatment 2	c_trt2	scalar		numeric
Utility weights					
	Healthy individuals	u_H	scalar		numeric

Element	Description	R name	Data structure	Dimensions	Data type
	Sick individuals in the Sick state	u_S1	scalar		numeric
	Sick individuals in the Sicker state	u_S2	scalar		numeric
	Dead individuals	u_D	scalar		numeric
	Being treated	u_trt1	scalar		numeric
	Transition weights				
	Utility decrement of healthy individuals when transitioning to the Sick state	du_HS1	scalar		numeric
	Cost of healthy individuals when transitioning to the Sick state	ic_HS1	scalar		numeric
	Cost of dying	ic_D	scalar		numeric
P	Age-dependent transition probability array	a_P	array	$n_states \times n_states \times n_t$	numeric
A	Transition dynamics array	a_A	array	$n_states \times n_states \times (n_t + 1)$	numeric
	Number of tunnel states	n_tunnel_size	scalar		numeric
	Tunnel names of the Sick state	v_Sick_tunnel	vector	$1 \times n_t$	numeric
	Number of states including tunnel states	n_states_tunnels	scalar		numeric
	State names including tunnel states	v_n_tunnels	vector	$1 \times n_states_tunnels$	categorical
	Initial state vector for the model with tunnels	v_s_init_tunnels	vector	$1 \times n_states_tunnels$	numeric
	Transition dynamics array for the model with tunnels	a_A_tunnels	array	$n_states_tunnels \times n_states_tunnels \times (n_t + 1)$	numeric
	Transition probability array for the model with tunnels	a_P_tunnels	array	$n_states_tunnels \times n_states_tunnels \times n_t$	numeric
R_u	Transition rewards for effects	a_R_u	array	$n_states \times n_states \times (n_t + 1)$	numeric
R_c	Transition rewards for costs	a_R_c	array	$n_states \times n_states \times (n_t + 1)$	numeric
Y_u	Expected effects per states per cycle	a_Y_u	array	$n_states \times n_states \times (n_t + 1)$	numeric
R_c	Expected costs per state per cycle	a_Y_c	array	$n_states \times n_states \times (n_t + 1)$	numeric
	Expected QALYs per cycle	v_qaly	vector	$1 \times (n_t + 1)$	numeric
	Expected costs per cycle	v_cost	vector	$1 \times (n_t + 1)$	numeric

Element	Description	R name	Data structure	Dimensions	Data type
	Total expected discounted QALYs for all strategies	<code>v_tot_qaly</code>	vector	1 x <code>n_str</code>	numeric
	Total expected discounted costs for all strategies	<code>v_tot_cost</code>	vector	1 x <code>n_str</code>	numeric
	Summary of the model outcomes	<code>df_cea</code>	data frame		
	Summary of the model outcomes - reformatted	<code>table_cea</code>	table		

Table II: Input parameters for probabilistic analysis

Parameter	Distribution	Distribution values	Parameter mean	Parameter standard deviation
Number of simulation	n_sim	1000		
Annual transition probabilities				
- Disease onset (H to S1)	Beta	$\alpha = 30, \beta = 170$	0.15	0.025
- Recovery (S1 to H)	Beta	$\alpha = 60, \beta = 60$	0.5	0.045
- Disease progression (S1 to S2) in the age-dependent model	Beta	$\alpha = 84, \beta = 716$	0.105	0.01
- Weibull scale parameter (S1 to S2) in the model with tunnel states	Lognormal	$\log(\mu) = \log(0.08), \log(\sigma) = 0.02$	0.08	0.002
- Weibull shape parameter (S1 to S2) in the model with tunnel states	Lognormal	$\log(\mu) = \log(1.1), \log(\sigma) = 0.02$	1.1	0.02
Annual mortality				
- Hazard ratio of death in S1 vs H	Lognormal	$\log(\mu) = \log(3), \log(\sigma) = 0.01$	3	0.03
- Hazard ratio of death in S2 vs H	Lognormal	$\log(\mu) = \log(10), \log(\sigma) = 0.02$	10	1
- Log odds ratio of S1 to S2	Normal	$\mu = \log(0.6), \sigma = 0.1$	-0.51	0.1
Annual costs				
- Healthy individuals	Gamma	shape = 100, scale = 20	2000	200
- Sick individuals in S1	Gamma	shape = 177.8, scale = 22.5	4000	300
- Sick individuals in S2	Gamma	shape = 225, scale = 66.7	15000	1000
- Cost of treatment A for individuals in S1 or S2	Gamma	shape = 576, scale = 20.8	12000	500
- Cost of treatment B for individuals in S1 or S2	Gamma	shape = 676, scale = 19.2	13000	500
Utility weights				
- Healthy individuals	Beta	$\alpha = 200, \beta = 3$	0.985	0.008
- Sick individuals in S1	Beta	$\alpha = 130, \beta = 45$	0.74	0.033
- Sick individuals in S2	Beta	$\alpha = 230, \beta = 230$	0.5	0.023
Intervention effect				
- Utility for treated individuals in S1	Beta	$\alpha = 300, \beta = 15$	0.95	0.012
Transition rewards				
- Disutility (H to S1)	Beta	$\alpha = 11, \beta = 1088$	0.01	0.003
- Increase in cost (H to S1)	Gamma	$\alpha = 25, \beta = 40$	1000	200
- Increase in cost (D)	Gamma	$\alpha = 100, \beta = 20$	2000	200