PACBOARD: Probabilistic Analysis dashBOARD

Appendix A: Health Economic Model Description

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Description

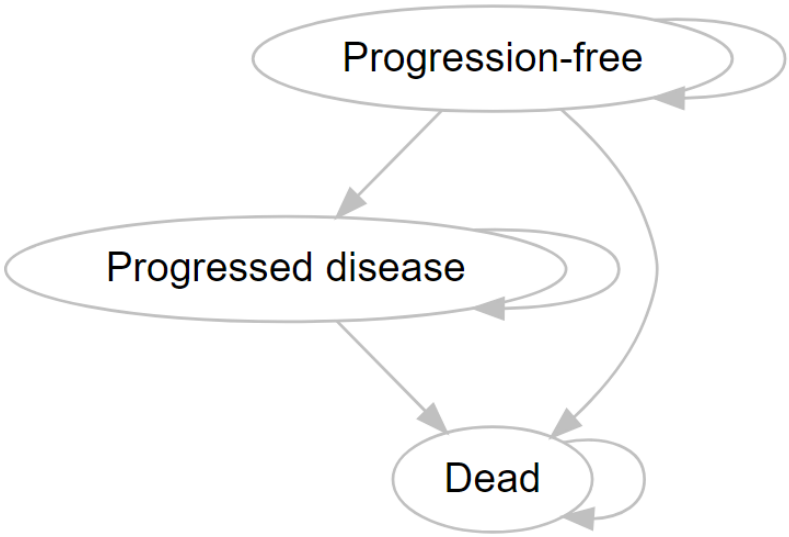
This Appendix describes the probabilistic model inputs and outputs of the mock health economic model developed to tests the functionalities of the Probabilistic Analysis Check dashBOARD (PACBOARD). The HE model and functions are available at https://github.com/Xa4P/pacheck. The inputs and outputs value are stored within the `df_pa` object of the `pacheck` package. The `df_pa` object is obtained by running the `01-data_preparation.R` R script.

Model description

The health economic (HE) model compares two strategies, called "intervention" and "comparator" for the treatment of mestatatic breast cancer. We used a yearly cycle and a time horizon of 30 years. We did not apply half cycle correction.

Model structure & assumptions

A cohort-based Health State Transition Model model with three health states was developed. The health states were: "Progression-free" (PF), "Progressed disease" (PD), and "Dead" (D). All individuals of the cohort start in the PF health state and can progress to the PD health state or to the D health state. Once individuals are in the PD health state, they cannot transit back to the PF health state but they can transit to the D health state. The D health state is the absorbing health state. The model structure is provided below.
The "intervention strategy" only reduces the transition probability from PFS to PD compared to the "comparator" strategy.
The "comparator" strategy does not incur any treatment or adverse event-related health losses and costs. Adverse events are assumed to occur once at the start of the health economic model.



Model inputs

The probabilistic model inputs were estimated based on the below-described distribution and parameter estimates, using the `generate_pa_inputs()` function.

Table 1: Overview of the HE model input values

Parameter name	Description	Mean value	Standard Error (or 95%CI)	Distribution
`p_pfspd`	Probability of transiting from PF to PD	0.15	0.04*	Dirichlet
`p_pfsd`	Probability of transiting from PF to D	0.1	0.03*	Dirichlet
`p_pdd`	Probability of transiting from PD to D	0.2	0.04	Beta
`p_ae`	Probability of experiencing an adverse event (intervention only)	0.05	0.02	Beta
`rr`	Relative risk of progression (PF to PD) of the intervention versus the comparator	0.75	0.62-0.88	Lognormal
`u_pfs`	Utility value of health state PF	0.75	0.07	Beta

Parameter name	Description	Mean value	Standard Error (or 95%CI)	Distribution
u_pd	Utility value of health state PD	0.55	0.1	Beta
u_ae	Utility decrement when experiencing an adverse event	0.15	0.05	Beta
c_pfs	Annual costs of health state PF	1000	200	Normal
c_pd	Annual costs of health state PD	2000	400	Normal
c_thx	Annual costs treatment (intervention)	10000	100	Normal
c_ae	Costs of treating an adverse event	500	100	Gamma
r_d_effects	Annual discount rate effects	0.015	-	Fixed
r_d_costs	Annual discount rate costs	0.04	-	Fixed

*Calculated based on the output of the Dirichlet distribution

Analysis

A probabilistic analysis of 10,000 iterations was performed through Monte Carlo analysis. Input and intermediate and final output values for each iteration were recorded. The recorded outputs were:
- t_ly_int & t_ly_comp: total discounted life years for each strategy
- t_ly_d_int & t_ly_d_comp: total undiscounted life years for each strategy
- t_qaly_int & t_qaly_comp: total discounted quality-adjusted life years for each strategy
- t_qaly_d_int & t_qaly_d_comp: total undiscounted quality-adjusted life years for each strategy
- t_costs_int & t_costs_comp: total discounted costs for each strategy
- t_costs_d_int & t_costs_d_comp: total undiscounted costs for each strategy
- t_ly_pfs_d_int, t_ly_pd_d_int, t_ly_pfs_d_comp & t_ly_pd_d_comp: discounted life years per health state for each strategy
- t_qaly_pfs_d_int, t_qaly_pd_d_int, t_qaly_pfs_d_comp & t_qaly_pd_d_comp: discounted quality-adjusted life years per health state for each strategy
- t_costs_pfs_d_int, t_costs_pd_d_int, t_costs_pfs_d_comp & t_costs_pd_d_comp: discounted costs per health state for each strategy
- t_qaly_ae_int: total QALY decrement associated with the occurrence of adverse events
- t_costs_ae_int: total costs associated with the occurrence of adverse events
- inc_ly: incremental (discounted) life years of the intervention versus the comparator
- inc_qaly: incremental (discounted) quality-adjusted life years of the intervention versus the comparator

- `inc_costs`: incremental (discounted) costs of the intervention versus the comparator
The probabilistic analysis is performed using a for loop and the function `perform_simulation()`.

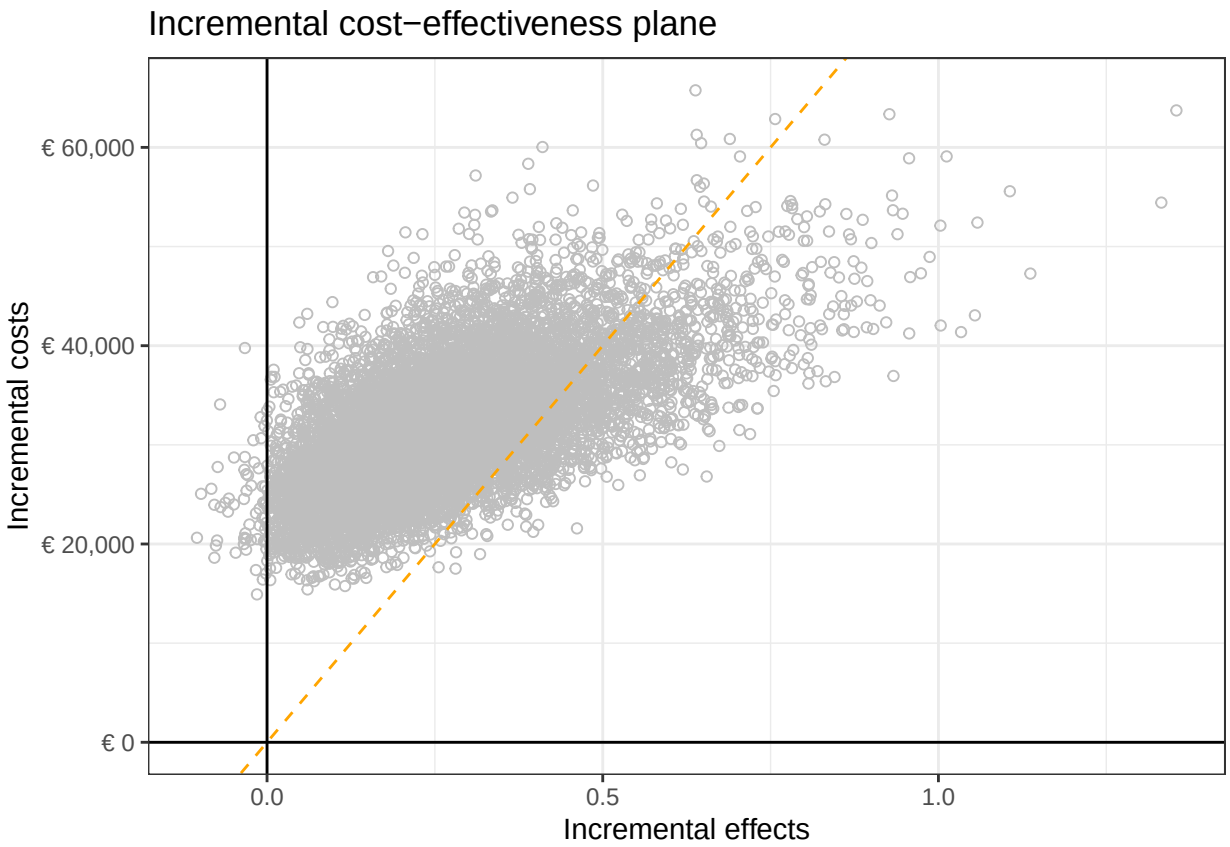
Results

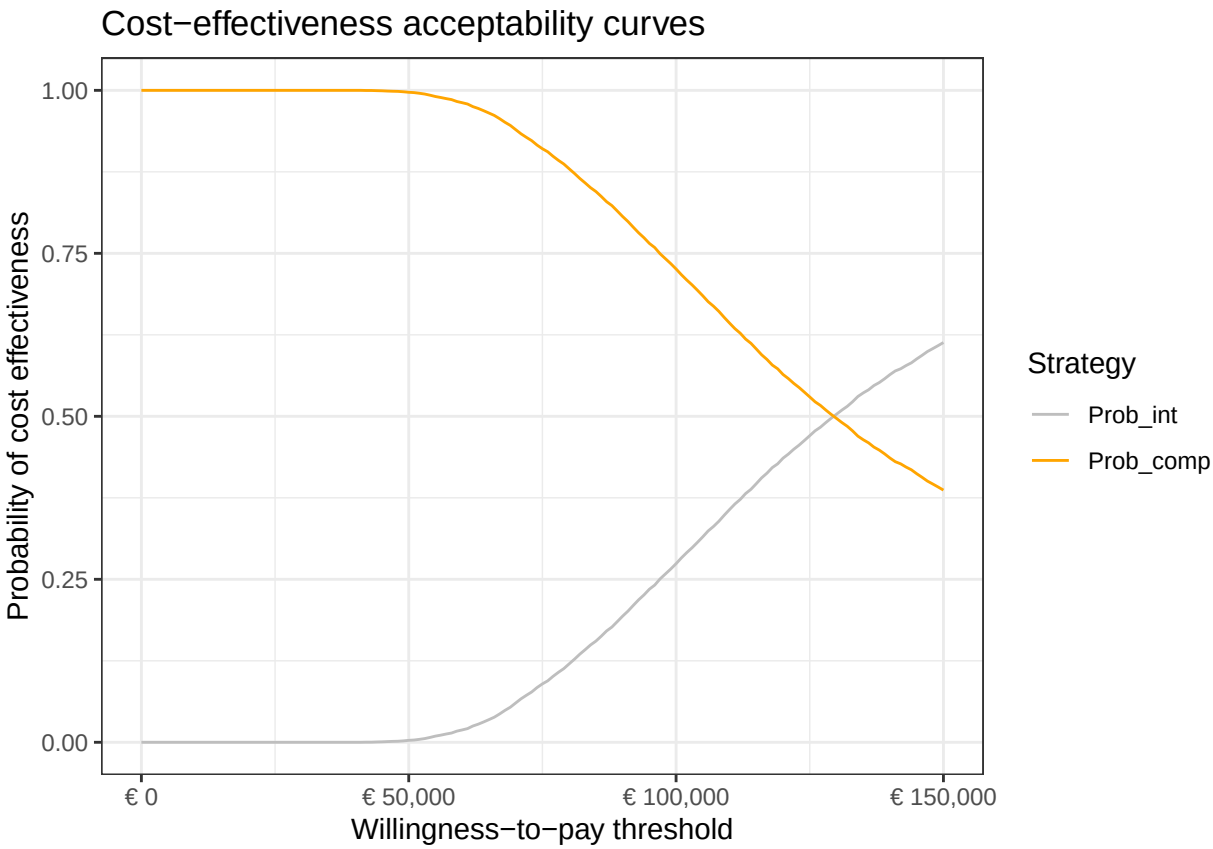
The intervention results in 0.28 incremental life years, 0.27 incremental quality-adjusted life years, and € 31,658 incremental costs versus the comparator. The incremental cost effectiveness ratio of the intervention versus the comparator is € 117,790 per QALY.
The probabilistic results of this HE model are provided in the table below and are plotted in an incremental cost-effectiveness plane (displaying a willingness to pay threshold line of €80,000 per QALY) and a cost-effectiveness acceptability curve.

Table 2: Overview of the results of the HE model

Strategy	Total LY	Total QALY	Total costs	Inc. QALY	Inc. costs	ICER per QALY
Comparator	5.67	3.71	€ 7,246	-	-	-
Intervention	5.96	3.98	€ 38,904	0.27	€ 31,658	€ 117,790

Abbreviations: ICER = incremental cost-effectiveness ratio; Inc. = incremental; LY = life years; QALY = quality-adjusted life years


Incremental cost−effectiveness plane
€ 60,000
€ 40,000
€ 20,000
€ 0
Incremental costs
0.0
0.5
1.0
Incremental effects


Cost−effectiveness acceptability curves
Probability of cost effectiveness
1.00
0.75
0.50
0.25
0.00
€ 0
€ 50,000
€ 100,000
€ 150,000
Willingness−to−pay threshold
Strategy
Prob_int
Prob_comp