Health Economic Modeling in R: A Hands-on Introduction

Decision Trees in R

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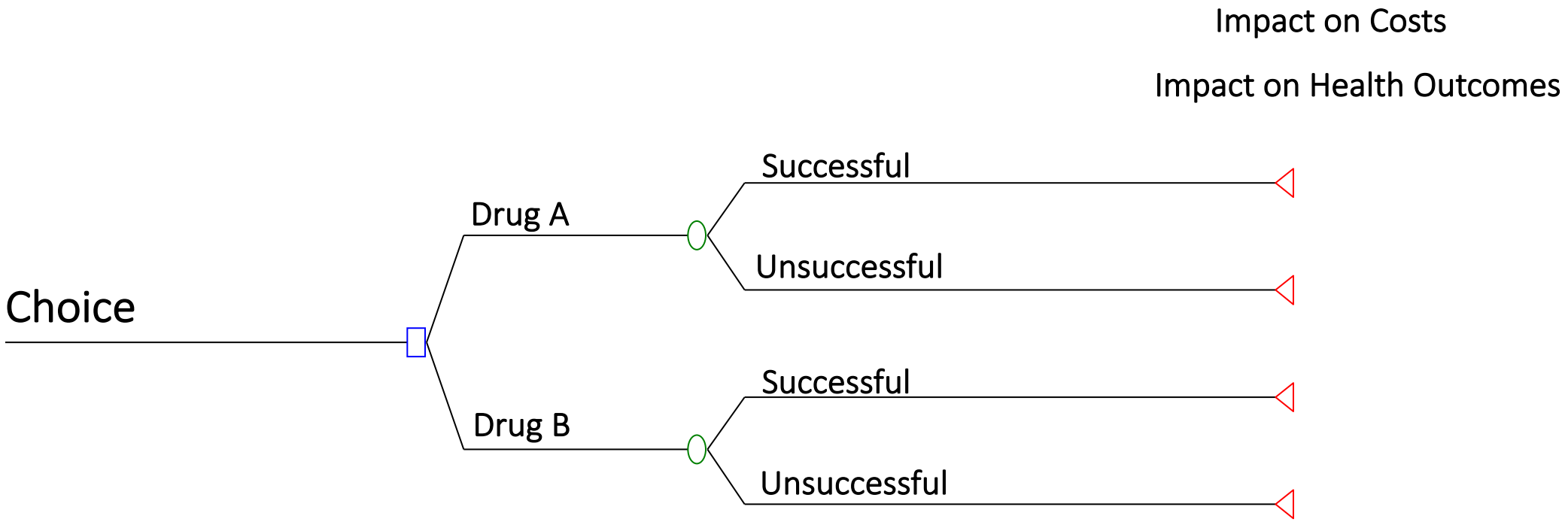
Model Types

- Cohort decision tree
- Cohort Markov model
- Individual level state transition models (microsimulation)
- Dynamic transition models
- Discrete event simulation

A Comparative Analysis of Alternative Courses of Action



Quality Adjusted Life Year (QALY)

- The most common measure of consequences in a cost-utility analysis
- Captures gains from reduced morbidity and reduced mortality of a disease and integrates them into a single measure
- Continuous scale (often from 0 to 1)
- “Measure of a person’s length of life weighted by a valuation of their health-related quality of life” ~ NICE UK

Incremental Cost-Effectiveness Ratio

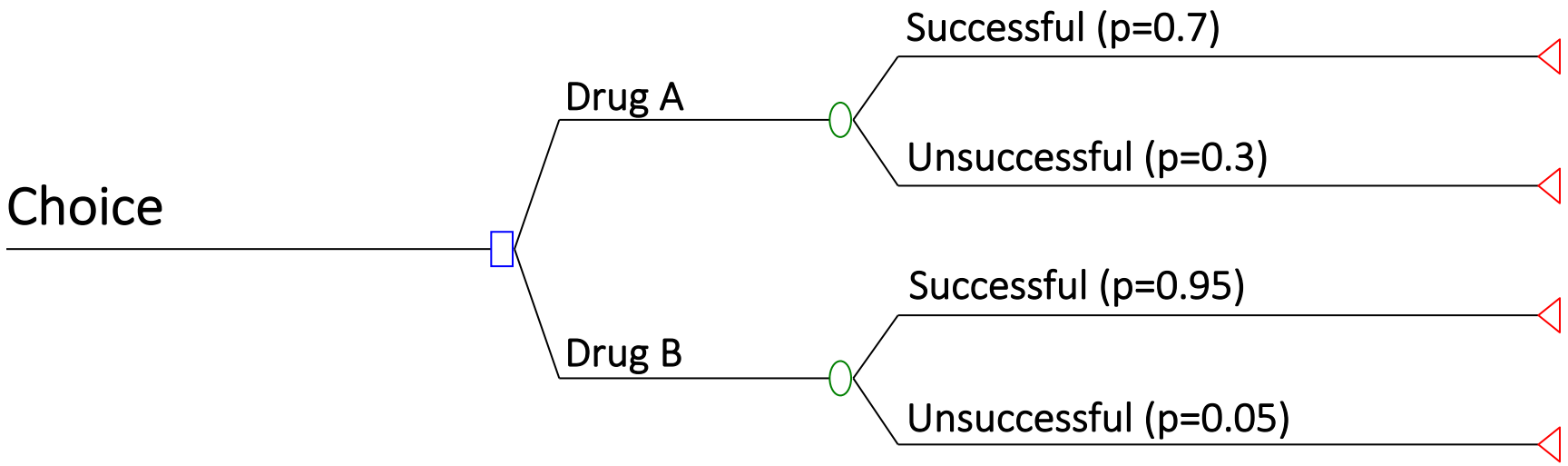
ICER (or more accurately an ICUR!)

$$ICER = \frac{Cost_A - Cost_B}{QALY_A - QALY_B}$$

The larger the ICER, the more money required to buy each unit of outcome and the less cost-effective the intervention.

Example: Decision Tree in R

Simple Decision Tree



QALYs

QALYs over patients lifetime if successful

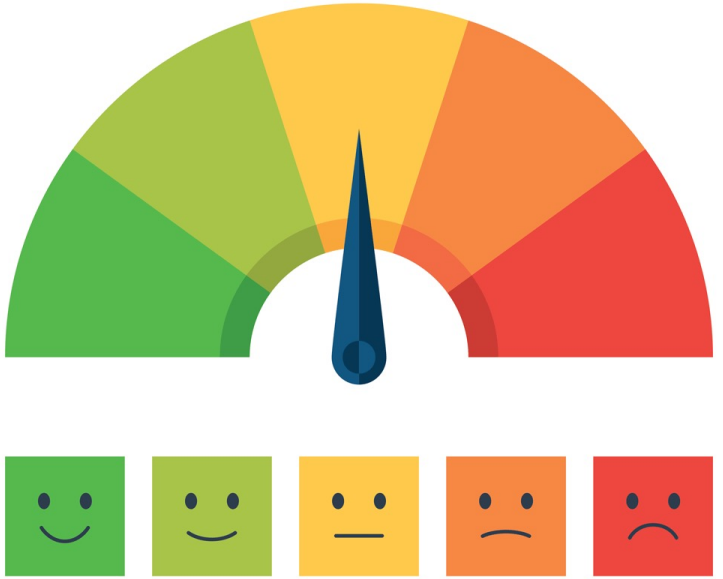
Drug A - 30

Drug B - 25

QALYs over patients lifetime if unsuccessful

Drug A - 15

Drug B - 23



Costs

Drug A - £2,000

Drug B - £150

Costs over patients lifetime if successful

Drug A - £10,000

Drug B - £5,000

Costs over patients lifetime if unsuccessful

Drug A - £20,000

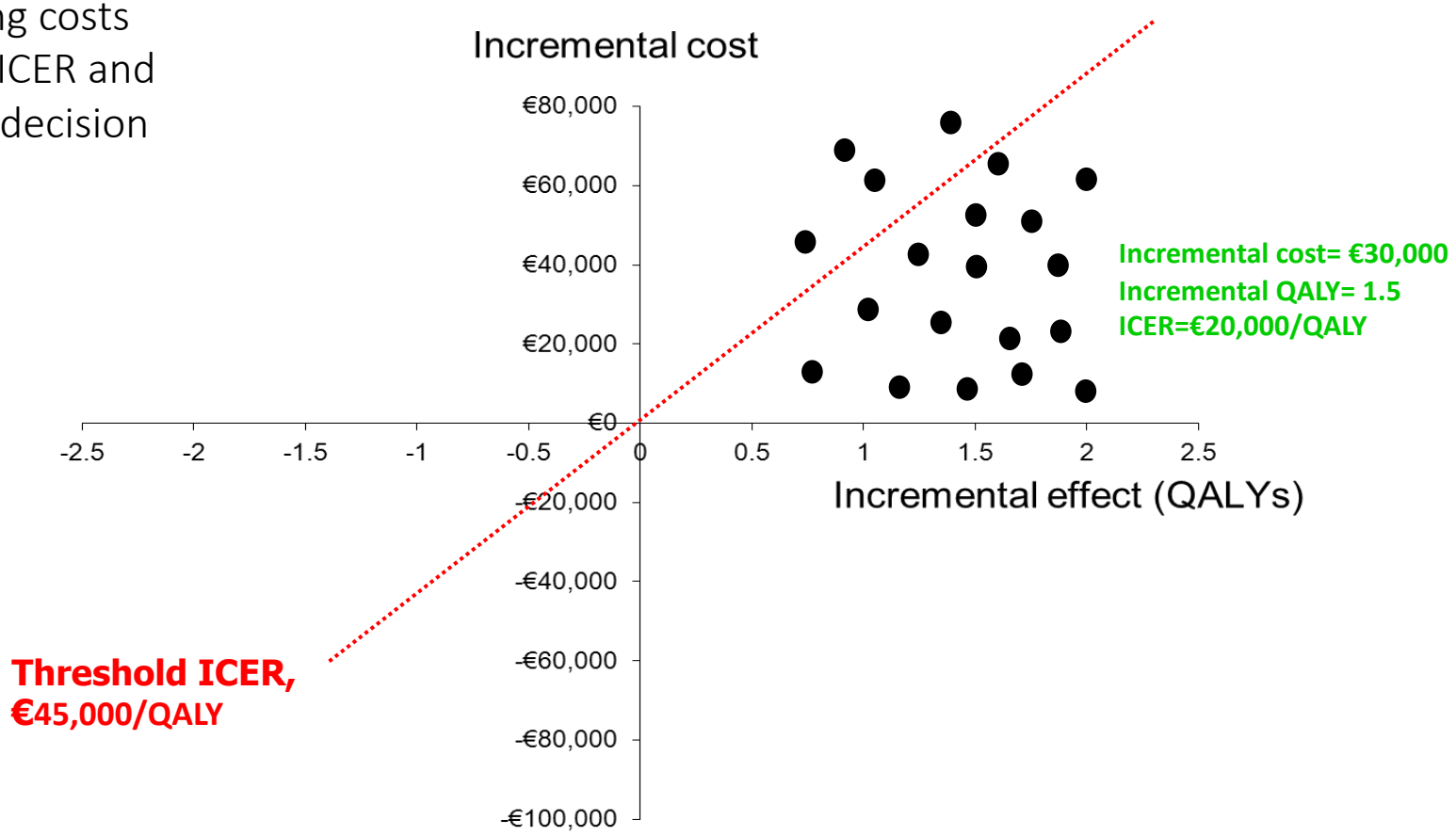
Drug B - £10,000

Modelling Uncertainty in R

Making the right choice?

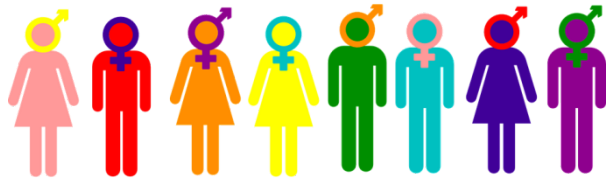
Incremental cost effectiveness plane

Uncertainty surrounding costs and QALYs can change ICER and potentially change the decision



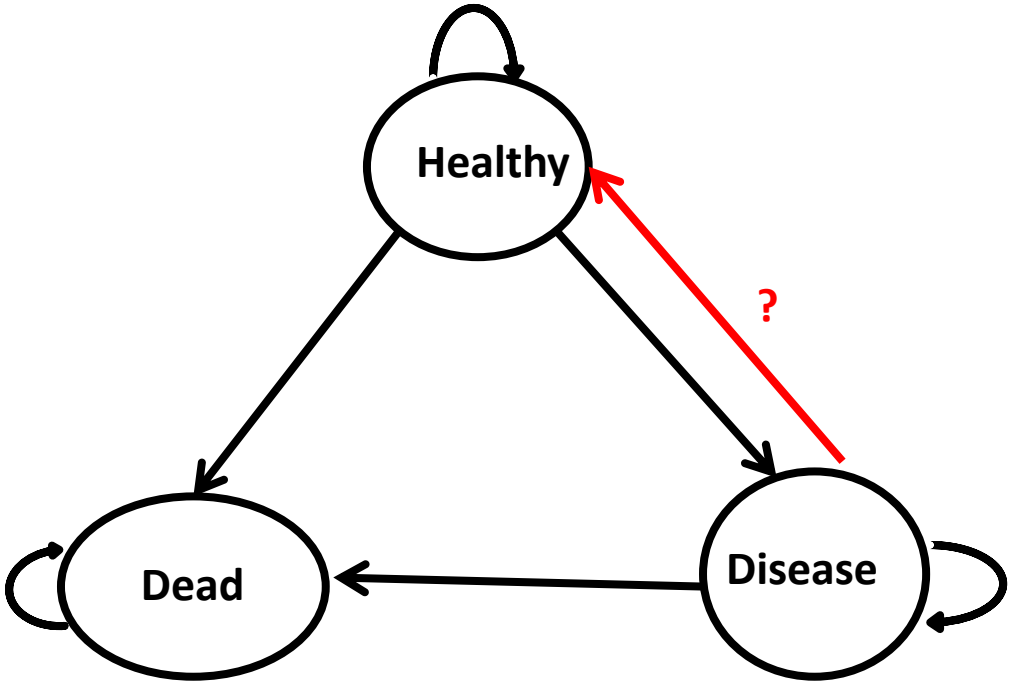
Sources of Uncertainty

- Stochastic uncertainty
  - Variability that naturally occurs between individuals with identical information
- Heterogeneity
  - Extent to which uncertainty can be explained by the characteristics of individuals, e.g. age, gender, other risk factors
- Parameter uncertainty
  - Refers to the uncertainty surrounding the estimation of input parameters from data sources



Sources of Uncertainty

- Structural uncertainty
  - assumptions inherent in the decision model
  - e.g. if patients attain a certain level of disease, can those patients be classified as cured? i.e. transition from disease to healthy?



Probabilistic sensitivity analysis

- For each parameter, instead of using mean/median values, best-estimate or upper/lower limit, a probability distribution is specified e.g. normal, log-normal, beta, gamma etc.

- The distribution represents both the range of values that the parameter can take as well as the probability that it takes any particular value

- Uncertainty is then propagated through the model by randomly selecting values from these distributions for each model parameter: repeatedly e.g. 1000 times