Sumatriptan versus caffeine for migraine

A decision tree example

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Introduction

This vignette is an example of modelling a decision tree using the `rdecision` package. It is based on the example given by Briggs (2006, Box 2.3) which itself is based on a decision tree which compared oral Sumatriptan versus oral caffeine/Ergotamine for migraine (Evans et al. 1997).

Creating the model

The following code constructs the decision tree, node by node. In the formulation used by `rdecision`, each node is a potentially recursive structure which is allowed to have zero or more child nodes; any child nodes must have already been declared before their parent node is declared. This implies that a tree should be constructed from right to left, starting with leaf nodes which have no children (leaf nodes are synonymous with pathways in Briggs' terminology). The final node to be constructed is the left-most decision node in the model.

```
# Sumatriptan branch
leaf.a <- LeafNode$new("A", utility=1.0)
leaf.b <- LeafNode$new("B", utility=0.9)
leaf.c <- LeafNode$new("C", utility=-0.3)
leaf.d <- LeafNode$new("D", utility=0.1)
leaf.e <- LeafNode$new("E", utility=-0.3)

c.8 <- ChanceNode$new(
  p = list(0.998, 0.002),
  children = list(leaf.d, leaf.e),
  edgelabels = list("Relief", "Hospitalization"),
  costs = list(0, 1093.0)
)

c.4 <- ChanceNode$new(
  p = list(0.594, 0.406),
  children = list(leaf.a, leaf.b),
  edgelabels = list("No recurrence", "Recurrence relieved with 2nd dose"),
  costs = list(0, 16.10)
)

c.5 <- ChanceNode$new(
  p = list(0.920, 0.080),
  children = list(leaf.c, c.8),
```

```
  edgelabels = list("Endures attack", "ER"),
  costs = list(0, 63.16)
)

c.2 <- ChanceNode$new(
  p = list(0.558, 0.442),
  children = list(c.4, c.5),
  edgelabels = list("Relief", "No relief"),
  costs = list(0, 0)
)

# Caffeine/Ergotamine branch
leaf.f <- LeafNode$new("F", utility=1.0)
leaf.g <- LeafNode$new("G", utility=0.9)
leaf.h <- LeafNode$new("H", utility=-0.3)
leaf.i <- LeafNode$new("I", utility=0.1)
leaf.j <- LeafNode$new("J", utility=-0.3)

c.9 <- ChanceNode$new(
  p = list(0.998, 0.002),
  children = list(leaf.i, leaf.j),
  edgelabels = list("Relief", "Hospitalization"),
  costs = list(0, 1093.0)
)

c.6 <- ChanceNode$new(
  p = list(0.703, 0.297),
  children = list(leaf.f, leaf.g),
  edgelabels = list("No recurrence", "Recurrence relieved with 2nd dose"),
  costs = list(0, 1.32)
)

c.7 <- ChanceNode$new(
  p = list(0.920, 0.080),
  children = list(leaf.h, c.9),
  edgelabels = list("Endures attack", "ER"),
  costs = list(0, 63.13)
)

c.3 <- ChanceNode$new(
  p = list(0.379, 0.621),
  children = list(c.6, c.7),
  edgelabels = list("Relief", "No relief"),
  costs = list(0, 0)
)

# decision node
d.1 <- DecisionNode$new(
  children = list(c.2, c.3),
  edgelabels = list("Sumatriptan", "Caffeine/Ergotamine"),
  costs = list(16.10, 1.32)
)
```

Running the model

The method `evaluatePathways` of decision nodes computes the probability, cost and utility of traversing each root-to-leaf path in the model. In the Sumatriptan model there are eight such paths, each of which begins with the decision node and ends with a leaf node. For example, pathway A involves a traversal of nodes `d.1`, `c.2`, `c.4` and `leaf.a`.

Model results

The results of the scenario model, using the code from the previous sections, yields the following result:

Choice	Pathway	Probability	Cost	Expected Cost	Utility	Expected Utility
Sumatriptan	A	0.331	16.10	5.34	1.0	0.33145
Sumatriptan	B	0.227	32.20	7.29	0.9	0.20389
Sumatriptan	C	0.407	16.10	6.55	-0.3	-0.12199
Sumatriptan	D	0.035	79.26	2.80	0.1	0.00353
Sumatriptan	E	0.000	1172.26	0.08	-0.3	-0.00002
Caffeine/Ergotamine	F	0.266	1.32	0.35	1.0	0.26644
Caffeine/Ergotamine	G	0.113	2.64	0.30	0.9	0.10131
Caffeine/Ergotamine	H	0.571	1.32	0.75	-0.3	-0.17140
Caffeine/Ergotamine	I	0.050	64.45	3.20	0.1	0.00496
Caffeine/Ergotamine	J	0.000	1157.45	0.12	-0.3	-0.00003

There are, as expected, eight root-to-leaf pathways. The total probability, expected cost and expected utility for each choice can be calculated from the table above, or by invoking the `evaluateChoices` method of a decision node. This gives the following result, consistent with that reported by Evans *et al* (1997).

Choice	Expected Cost	Expected Utility
Caffeine/Ergotamine	4.71	0.20128
Sumatriptan	22.06	0.41686

References

Briggs, Andrew, Karl Claxton, and Mark Sculpher. 2006. *Decision Modelling for Health Economic Evaluation.* Oxford, UK: Oxford University Press.

Evans, Kenneth W., John A. Boan, John L. Evans, and Ashfaq Shuaib. 1997. "Economic Evaluation of Oral Sumatriptan Compared with Oral Caffeine/Ergotamine for Migraine." *Pharmacoeconomics.*