

School of Computer Science and Software Engineering
 Monash University, Clayton Campus
 Computer Science
 Semester I, 2004

Bayesian Models CSE458 Exercise 2

An Oil Drilling Problem

The following problem is based on a famous problem in H. Raiffa, *Decision Analysis: Introductory Lectures on Choices under Uncertainty*, Addison-Wesley, 1968.

*An oil wildcatter must decide whether to drill or don't drill. The cost of drilling is uncertain. It could be \$4,000,000 with probability 0.2, \$5,000,000 with probability 0.7 and \$7,000,000 with probability 0.1. Also, the oilcatter is uncertain whether the hole is **dry**, **wet**, or **soaking**. His payoffs are given in Table 1.*

State	Drill	Don't Drill
Dry	\$0	\$0
Wet	\$12,000,000	\$0
Soaking	\$270,000,000	\$0

Table 1

*At a cost of \$100,000 the wildcatter could take standard seismic soundings which will help determine the underlying geological structure of the site. The soundings will disclose whether the terrain below has **no structure**, or an **open structure**, or a **closed structure**. Table 2 provides the joint probabilities of the structure of the terrain and the true state of the hole.*

True State	Seismic outcome		
	No Structure	Open Structure	Closed Structure
Dry	<i>0.30</i>	<i>0.15</i>	<i>0.05</i>
Wet	<i>0.09</i>	<i>0.12</i>	<i>0.09</i>
Soaking	<i>0.02</i>	<i>0.08</i>	<i>0.10</i>

Table 2

The oilcatter could also use an experimental device which will give an indication of the subsurface structure, but with occasional errors.

This experiment costs only \$30,000 and Table 3 provides the conditional probabilities of the structure indicated from the experiment given the true underlying structure.

Underlying Structure	Structure indicated by experiment		
	No Structure	Open Structure	Closed Structure
No Structure	0.90	0.10	0.00
Open Structure	0.20	0.70	0.10
Closed Structure	0.10	0.30	0.60

Table 3

1. Using a decision flow diagram decide what the wildcatter should do.
2. State how many pure strategies there are for the wildcatter.
3. Suppose the wildcatter uses the following utility function:

$$u(x) = 1 - e^{-x/200,000,000}.$$

Now what should the wildcatter do?