

**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	0.30	0.15	0.05
Wet	0.09	0.12	0.09
Soaking	0.02	0.08	0.10

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?