

Business Decision Analytics under Uncertainty

Spring 2017, Professor Eckstein

Homework 2

Due Wednesday, February 8

Q1: Gas Drilling

Your firm is in the natural gas extraction business, and has acquired rights to a plot of land which it believes has a 50% chance of containing \$40 million worth of natural gas, and a 50% chance of being completely “dry” (that is, containing no commercially exploitable gas). Drilling a full-scale gas well on the site will cost \$21 million.

Before deciding whether to drill, you have the option to perform a “test bore”, which costs only \$2 million. The “test bore” can have three possible results, “positive”, “inconclusive”, and “negative”. For past sites that have contained commercially exploitable gas, your test bore procedure has yielded a positive result 50% of the time, an inconclusive result 30% of the time, and a negative result 20% of the time. On sites known to be “dry”, your test bore procedure has yielded a positive result 10% of the time, an inconclusive result 30% of the time, and a negative result 60% of the time.

(a) Compute the following:

- The probabilities the test bore will yield positive, inconclusive, or negative result on this plot of land
- The probabilities that the well drilled on the site will have gas, given a positive, inconclusive, or negative result for the test bore, respectively.

(b) Assuming that you wish to be guided by the EMV decision criterion, develop a decision tree that tells you the optimal course of action to take. Describe the optimal policy and its EMV.

(c) What is the EVSI of the test bore procedure?

(d) What is the EVPI in this situation?

Q2: Product Rollouts

Your firm has developed a new product aimed at the European and Asian markets. For each of these two markets, you have identified two possible sales scenarios, called “good” and “bad”, with the following probabilities:

	Europe Good	Europe Bad
Asia Good	0.55	0.15
Asia Bad	0.20	0.10

That is, there is a 55% chance the products sales will be good in Asia and Europe, a 15% chance they will be good in Asia but bad in Europe, and so forth.

You have four possible courses of action:

- Introduce the product simultaneously in Europe and Asia
- Introduce it in Asia first. After it becomes apparent whether sales are good or bad, decide whether to introduce it in Europe, one year later.
- Introduce it in Europe first. After it becomes apparent whether sales are good or bad, decide whether to introduce it in Asia, one year later.
- Abandon the product.

The NPV's of the various scenarios are as follows, in millions of US dollars:

	Immediate Introduction		After one year	
	Good	Bad	Good	Bad
Asia	+120	-205	+117	-205
Europe	+105	-200	+102	-200

For example, “good” sales in Asia mean an NPV of \$120 million if the product is introduced in this year, and \$117 million in the product is introduced next year. In either year, “bad” sales mean an NPV of -\$205 million. The information for Europe should be interpreted similarly.

(a) Calculate:

- **The probability of good sales in Asia**
- **The probability of good sales in Europe**
- **The probability of good sales in Asia, given that good sales are observed in Europe**
- **The probability of good sales in Asia, given that bad sales are observed in Europe**
- **The probability of good sales in Europe, given that good sales are observed in Asia**
- **The probability of good sales in Europe, given that bad sales are observed in Asia.**

(b) Use a decision tree to determine the best introduction strategy for the product from the standpoint of EMV. State the optimal policy and its EMV.