

Decision Analysis

Tutorial Problem 2

A year ago a major potato producer suffered serious losses when a virus affected the crop at the company's North Holt farm. Since then, steps have been taken to eradicate the virus from the soil and the specialist who directed these operations estimates, on the basis of preliminary evidence, that there is a 70% chance that the eradication programme has been successful.

The manager of the farm now has to decide on his policy for the coming season and he has identified two options:

- (1) He could go ahead and plant a full crop of potatoes. If the virus is still present an estimated net loss of £20,000 will be incurred. However, if the virus is absent, an estimated net return of £90,000 will be earned.
- (2) He could avoid planting potatoes at all and turn to the entire acreage over to an alternative crop. This would almost certainly lead to net returns of £30,000.

The manager is now informed that Ceres Laboratories could carry out a test on the farm, which will indicate whether or not the virus is still present in the soil. The test is not perfectly reliable. If the virus is still present in the soil the test has only a 90% chance of detecting it, while if the virus has been eliminated there is a 20% chance that the test will incorrectly indicate its presence.

What is the expected value of this imperfect test information?

Decision Analysis

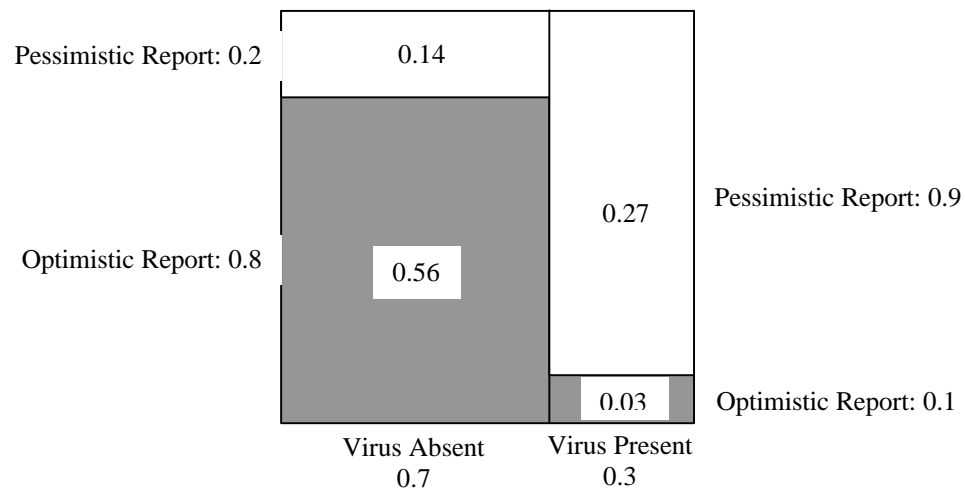
Solution to Tutorial Problem 2

Prior probabilities:

$$\Pr(\text{Virus Absent}) = 0.7$$

$$\Pr(\text{Virus Present}) = 0.3$$

Using Bayes' Theorem:



$$\Pr(\text{Optimistic Report}) = 0.56 + 0.03 = 0.59$$

$$\Pr(\text{Pessimistic Report}) = 0.14 + 0.27 = 0.41$$

Posterior Probabilities:

$$\Pr(\text{Virus Absent} \mid \text{Optimistic Report}) = 0.56 / 0.59 = 0.949$$

$$\Pr(\text{Virus Present} \mid \text{Optimistic Report}) = 0.03 / 0.59 = 0.051$$

$$\Pr(\text{Virus Absent} \mid \text{Pessimistic Report}) = 0.14 / 0.41 = 0.341$$

$$\Pr(\text{Virus Present} \mid \text{Pessimistic Report}) = 0.27 / 0.41 = 0.659$$

From the decision tree one can see that the expected values of the three possible actions are:

$$\text{Exp}(\text{go ahead with potatoes}) = 57\text{K}$$

$$\text{Exp}(\text{avoid potatoes}) = 30\text{K}$$

$$\text{Exp}(\text{first commission report}) = 62.1\text{K}$$

So the value of the report is: $62.1\text{K} - 57\text{K} = \mathbf{5.1\text{K}}$

