Verification with No Additional Information

Assume that Decision-maker, on the basis of past experience and knowledge (including all data already received), assigns a prior probability p to the statement that the true state is Red. Thus the prior probability of state Green is $1 - p$. We assume throughout that $0 < p < 1$.

A crucial quantity for Decision-maker is the threshold probability value

$$p_0 = \frac{F}{L - M + F}.$$

The value of p relative to p_0 determines Decision-maker's best course of action, which is

- Accept if $p < p_0$;
- Alarm if $p > p_0$.

(To avoid complicating the presentation with transitional cases, possible "chance" equalities of parameters, such as $p = p_0$, will be ignored.)

Thus, p_0 is the threshold separating the zone where Green is very likely (so Decision-maker should choose Accept) from the zone where Red is sufficiently likely that Decision-maker should choose Alarm. These two zones, and some expected cost lines to be discussed below, are shown in Figure 3 for the example

$F = 20 \quad L = 100 \quad M = 40$

In this example, the cost of failing to detect an actual violation is very high (100), but is reduced considerably (to 40) if the violation is detected. Also, the cost of a false alarm (20) is small, but not negligible. As long as there is no information source, the threshold separating the Accept zone from the Alarm zone is $p_0 = 0.25$.

In Figure 3, the heavy line labelled "0CM" represents Decision-maker's expected (or average) cost if the optimal decision policy given above is followed. Note that Decision-maker's expected cost increases as p increases, for as Decision-maker finds it more likely that the true state is Red, then it becomes more likely that the best that Decision-maker will be able to do (in this example) is to hold the cost to 40 units.

The straight line labelled "0M" in Figure 3 is important also. It is called Decision-maker's Expected Cost of Perfect Information and represents the expected cost in the event that Decision-maker knows for certain that he/she will learn the true state prior to taking his/her decision. Thus the vertical distance between the 0CM and 0M lines measures the extra expected cost that Decision-maker faces as a result of his/her uncertainty about the true state, when the subjective probability of Red is p. This height is therefore the maximum that Decision-maker would rationally pay to learn the true state.

Necessarily, therefore, Decision-maker will avoid any information source that provides only uncertain information about the true state and costs more than this maximum. As Figure 3 makes clear, a larger value of $L - M$ corresponds to a more pronounced kink in the 0CM line, which increases Decision-maker's willingness to pay for information — perfect or imperfect.

In summary, for any level of prior belief about the likelihood of a violation, there is a calculable ceiling on the cost of any worthwhile information. This ceiling rises as the amount lost by missing a violation increases.

Verification with Fixed Cost Information

Now, assume that Decision-maker has available a process yielding binary information. Binary information is information that has only two possible values, which will be called here

* *Clear*, recommending that Decision-maker choose **Accept**, and
* *Flag*, recommending that Decision-maker choose **Alarm**.

The most important characteristics of a process yielding binary information are its error probabilities and its cost. The error