Jane M. Simmons, AT&T Bell Laboratories Engineer's Notes, Public Release Version, July 31, 1995.

Value Of Information

It is important for a research organization to be able to evaluate the value of the work that is performed. If the nature of the job is such that the performance of a system is improved, the amount of improvement can be used as a gauge of the value of the work. However, if the nature of the job is to *determine* the performance of a system, as opposed to improving the performance, it is not as clear how to measure the value of such work. These notes describe a methodology that can help determine the value of information.

Background

Assume a manager is evaluating whether to go ahead with a project (or is trying to decide which project is the best option). In preparing the business case for the project, the manager will identify all costs, revenues, etc. In doing so, it is likely the manager will identify some unknown factors that may, for example, affect a particular revenue figure. The manager will specify a range of values for each unknown factor and an associated probability distribution. The manager will use the probability distributions to calculate the *expected* Net Present Value (NPV) of the project. The manager then decides whether to go ahead with the project based on whether the *expected NPV* is greater than a particular threshold.

Example

Consider the following example: assume a manager is trying to determine whether to proceed with the deployment of a new access network. The major unknown in the business case is the achievable sustained download speed of the network, for which a probability distribution is generated (for example, uniformly distributed between 1 and 4 Mbps). Using this distribution, assume that the NPV of the project is uniformly distributed between -$25 Million and +$75 Million. Thus, the expected NPV is +$25 Million.

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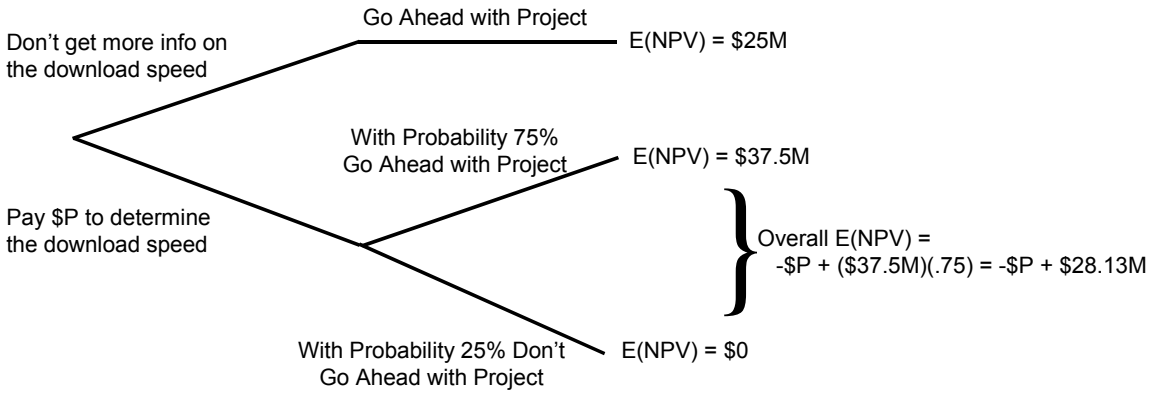
Assume that a researcher can determine the achievable download speed precisely (a bit unrealistic, but makes the math easier). The manager must determine the value of that information, so he can decide whether it is worth having the researcher do the work.

Assume that the manager will go ahead with the project if the NPV is positive. If the manager decides not to use the researcher, then based on the analysis above, he will go ahead with the project (because the E(NPV) is $25M). If the manager decides to use the researcher, he will pay an amount *P* for the researcher's time and receive a number *X*, the true download speed. If *X* yields a positive NPV for the project, then the manager will go ahead with the deployment. If *X* yields a negative NPV, then the project is cancelled. After the project is cancelled, the NPV is 0.

Based on the manager's estimate of the distribution of achievable download speeds, he should believe that there is a 25% chance that *X* will result in a negative NPV and a 75% chance that *X* will lead to a positive NPV. Conditioned on the event that the project is accepted, the E(NPV) is $37.5M (given the NPV is positive, the NPV is uniformly distributed between 0 and $75M).

The decision tree looks like the following:



Thus, if no more information is sought, the E(NPV) of the project is $25M. If more information is sought, the E(NPV) of the project is ($28.13M – P). Thus, the manager should be willing to pay up to $28.13M - $25M = $3.13M dollars for the researcher to determine the precise achievable download speed.

Note that the researcher has done nothing to *increase* the download speed. However, by providing information on the download speed, the researcher has increased the expected value of the project.